Story County Planning and Development
900 6th Street, Nevada, Iowa 50201
(515) 382-7245 — pzweb@storycountyiowa.gov — www.storycountyiowa.gov

CONDITIONAL USE PERMITS

1. Property Owner*

(Last Name) City of Nevada
(First Name)
(Address) 1209 6th Street
(City) Nevada (State) IA (Zip) 50201
(Phone) 515-382-5466 (Email) kwright@cityofnevadaiowa.org

2. Applicant (if different than owner)

(Last Name) Roth
(First Name) Michael
(Address) 5525 Merle Hay Road, Suite #200
(City) Johnston (State) IA (Zip) 50131
(Phone) 515-657-5304 (Email) mroth@hrgreen.com

3. Property Address 270th Street (Orchard View Subdivision, Lot 1) Parcel ID Number(s) 1131200305

4. Certification and Signature

I/we certify that the information and exhibits submitted are true and correct to the best of my knowledge and that in filing this application I am acting with the knowledge, consent and authority of the owners of the property. Pursuant to said authority, I hereby permit County officials to enter upon the property for the purpose of inspection.

***Acknowledgement of property owner is required and may occur via email or by signature of this application.**

Property Owner Signature Kevin Wright **Date** 8/14/20 **Applicant Signature** Michael Roth **Date** 8/14/20

There are 3 types of CUP Modifications: insignificant, minor, and major. The Director of Planning and Development makes the determination of the type. Insignificant modifications are reviewed by the director. Minor modifications are reviewed by the Board of Adjustment. Major modifications are considered new conditional use applications and follow the same review process as a new conditional use permit application.

☑ New Conditional Use Permit

Proposed Conditional Use: Wastewater Treatment Facility

Submittal Requirements:

- ☑ Attend conceptual review meeting (prior to submittal of CUP application, see conceptual review application and deadline on Planning and Development website)
- ☑ Filing Fee (required prior to processing): $275
- ☑ Site development plan
- ☑ Written narrative explaining justification for proposed conditional use permit and conformance to the standards for approval in Section 90.04 of the Story County Code of Ordinances.

☐ Conditional Use Permit Modification

Previous CUP and Number: _____

Submittal Requirements:

- ☐ Filing Fee (required prior to processing) : $50 (If determined to be a minor modification by the Planning and Development Director, the fee amount is $175.)
- ☐ Site development plan
- ☐ Written narrative explaining modification of approved conditional use permit and response to the standards for approval in Section 90.04 of the Story County Code of Ordinances.

Receipt No. _____
Receipt Amount _____

Conditional Use Permit Narrative

WWTF Improvements – Conditional Use Permit

City of Nevada, Iowa

August 2020

Prepared By:

HRGreen

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1. INTRODUCTION

1.1. Background

The current City of Nevada's Wastewater Treatment Facility (WWTF) is located at the northeast corner of the intersection of US 30 and 6th Street in Nevada and treats the residential, commercial and industrial wastewater flows that are collected and conveyed through the City's sanitary sewer collection system. The existing collection system consists of approximately 30 miles of sanitary sewer, 550 manholes, one lift station, and one equalization basin. The City's two permitted Significant Industrial Users (SIUs), Burke Corporation and the former DuPont Cellulosic Ethanol Plant, discharge to the City's collection system. The City continues to improve and rehabilitate the collection system and reduce wet weather flows received at the WWTF.

The existing WWTF has served the City for approximately 60 years and has been modified many times to accommodate expansion and upgrades. However, it does not have sufficient capacity for: 1) planned industry expansion by the Burke Corporation, which is projected to be completed by 2021 and will double its wastewater discharge, and; 2) projected population growth within the design period. The existing WWTF configuration is not readily amenable to be modified to provide additional effluent disinfection and nutrient removal requirements currently required by the Iowa Department of Natural Resources (IDNR). Additionally, the facility is near the end of its life due to infrastructure age.

The City considered options to renovate and expand the existing WWTF and build a new facility. Due to many reasons, including space constraints and separation from inhabitable buildings at the existing location, the decision was made to build a new facility on another site.

1.2. Site Selection

In early 2015, the City of Nevada began the search for a sufficiently sized parcel of land south of Nevada along the West Indian Creek corridor to accommodate the construction of a new WWTF. A site was sought that would allow discharge to West Indian Creek, be readily accessible, and provide adequate separation from inhabitable buildings. In early 2017, the City of Nevada purchased a123.5-acre parcel of farmland approximately three miles south of the existing Wastewater Treatment Facility along West Indian Creek for this purpose. This parcel is located along 270th Street southwest of the intersection with West Indian Creek. A minor subdivision was required to create the parcel to be purchased by the City, which was approved by Story County.

To accommodate the increased wastewater discharge from Burke Corporation, a construction start date for the new treatment facilities on this site is planned for November 2020, with completion by the end of 2023.

1.3. Facility Plan

A Facility Plan, which was completed by HR Green, Inc. in August 2019, was developed based on the requirements of the IDNR Design Standards. The existing loads and flows were reviewed, and design flows and loads were

established for the future residential projected population; non-Burke industrial loading limits, and the SIU Burke design loadings from their expansion.

A Waste Load Allocation (WLA) was developed for West Indian Creek as the proposed receiving stream adjacent to the new site. The WLA limits along with the Iowa Nutrient Reduction Strategy goals were used to evaluate wastewater treatment technologies considered in the report.

Two interceptor sewer alternatives and two WWTF alternatives were evaluated in detail. No evaluations of the existing collection system were included. The City of Nevada is currently implementing improvements to the existing collection system to reduce I&I flows.

Interceptor Sewer

The interceptor sewer alternatives propose to either:

S1) follow West Indian Creek with a gravity sewer before being pumped with a lift station to the headworks of the proposed WWTF, or

S2) to use a lift station and force main to pump flow from the existing WWTF site to Country Road S14 and subsequently conveyed via a gravity interceptor sewer to the new site.

The recommended interceptor sewer between the existing and new WWTF sites is Alternative S2, which locates the lift station at the existing WWTF site; force main along US Highway 30 to the intersection of County Road S14; and gravity interceptor sewer along County Road S14 to the new WWTF site. This route was chosen due to the following:

- Most economical
  - Avoids canyon-like corridor along West Indian Creek and the accompanying construction challenges
  - Shallower gravity sewer through most of the corridor
- Fewer permanent and temporary easements required
- Accessibility for construction and future operation/maintenance
- Avoids wooded corridor along creek

Wastewater Treatment

The main objective of the WWTF alternatives evaluation was to find an economical solution (capital and life-cycle costs) that best met the City's qualitative criteria:

- Ease of operation
- Process reliability to handle flow/loading spikes
- Ability to perform nutrient removal, specifically Enhanced Biological Phosphorus Removal (EBPR)

The evaluations for preliminary, primary, secondary, solids treatment, solids processing, biosolids storage, and effluent disinfection treatment processes were focused during a conceptual design workshop with the City at the beginning of this planning effort. Secondary treatment systems with nutrient removal capability were the only alternatives evaluated. Evaluated alternatives were:

1) Five-stage Bardenpho (P1), and
2) Three-stage Oxidation Ditch (P2).

Primary treatment was eliminated from both alternatives due to the negative impact on secondary treatment to achieve EBPR. The same preliminary treatment and disinfection processes were used for both alternatives' (P1 and P2) as these processes are not influenced by the secondary treatment system. Use of ultraviolet (UV) disinfection was ultimately chosen for both alternatives based on the City's preferences.

Solids treatment is most influenced by the type(s) of sludge produced. Due to no primary treatment processes, only waste activated sludge (WAS) from the secondary treatment system must be stabilized/treated. This resulted in evaluation of two different aerobic digestion processes for solids treatment. Post digestion dewatering was not evaluated due to the City's continued preference for liquid biosolids storage and disposal. Continued land application of biosolids was anticipated, influencing biosolids storage requirements for a minimum of 180 days of storage.

The recommended WWTF alternative is Alternative P2, Three-stage Oxidation Ditch, because of the best relative ability to meet the previously stated qualitative criteria.

1.4. Design

The City of Nevada entered into Agreement with HR Green, Inc. to design the Wastewater Treatment Facilities and the Interceptor Sewer in October 2019. It is anticipated the design will be complete by Fall 2020. The WWTF and the Interceptor Sewer will be bid as separate projects. It is anticipated the WWTF will be bid in two construction contracts, Fall 2020 (Phase 1) and in early 2021 (Phase 2), respectively. The Interceptor Sewer will be bid in Fall 2021. The WWTF will be completed and in operation by the end of 2023. The Interceptor Sewer should be completed in about a year.

<u>Opinion of Probable Cost</u>
The opinion of probable construction cost for the recommended WWTF and Interceptor Sewer is approximately $51,250,000.00.

1.5. Application Documents

The following documents will be included as part of the Conditional Use Permit that are not included as an appendix to this narrative:

1) Phase 1 90% Construction Documents
2) Phase 2 90% Construction Documents (site and applicable structure drawings only). Entire 90% set may be provided upon request.
3) Preliminary Interceptor Sewer Alignments
4) Facility Plan

2. NARRATIVE

2.1. Compatibility

The proposed WWTF site is currently classified as an A-1 Agricultural Zone. According to Table 90-1 of Story County's Code of Ordinances, "public water or sewage treatment facilities" are permitted conditional uses of this zone with the approval of a conditional use permit. The WWTF will is designed to be compatible with the current Agricultural Zoning classification of the site. All structures of the proposed WWTF will adhere to Story County land develop regulations including the Bulk Requirements found under the A-1 Agricultural Zone requirements. The total site property area is approximately 122.6 acres. The enclosed fenced portion of WWTF will only encompass approximately 17.5 acres of the site property. All structures will be placed with a minimum 50 ft setback from all property lines and no structure will exceed 40 feet in height.

The proposed wastewater treatment facility will have no interference with the development and use of adjacent properties. The majority of adjacent properties are classified as A-1 Agricultural Zones. The wastewater treatment facility will have no impact to agricultural classified zones. The remaining adjacent properties are classified as: (1) Agricultural Dwelling Zone and (1) Residential Zone. According to IDNR regulations, new WWTF's must maintain a 1,000-foot separation between inhabitable structures and wastewater treatment processes unless written permission is obtained from owners of inhabitable structures within the 1,000-foot separation distance. The proposed site allows greater than the required 1,000-foot separation to all inhabitable structures. The City of Nevada purchased the site property from the owner of the nearest inhabitable structure and have received certified permission for construction of the WWTF within 1,000-feet of that property. See **Appendix A** for that certification. Property owners are permitted to develop within the 1,000-foot separation distance once the WWTF is constructed, and thus the facility will have no impact to the neighboring properties' development. See **Figure 1** on the next page for a site separation map of the proposed WWTF processes to inhabitable structures.

As can be seen in **Figure 1**, the majority of the facility's 1,000-ft site separation is contained within the City of Nevada owned property. This is a great improvement from the existing Nevada WWTP, which is located within several hundred feet of residential properties. One of the greatest benefits of this site is its separation from other properties. Due to the large area of land the City of Nevada was able to purchase, this facility is ideally located as far as feasible from developed and/or residential areas. Given the location of the plant, it is not anticipated there will be any impact to adjacent properties' values or development ability. A similar WWTF is currently being constructed in Warren County, Iowa. An appraisal was performed with findings that the proposed WWTF would not diminish or impair established property values in adjoining or surrounding properties. See **Appendix B** for a formal appraisal of surrounding properties to the proposed Nevada WWTF. Formal appraisals are currently being assessed and will be provided as soon as available.

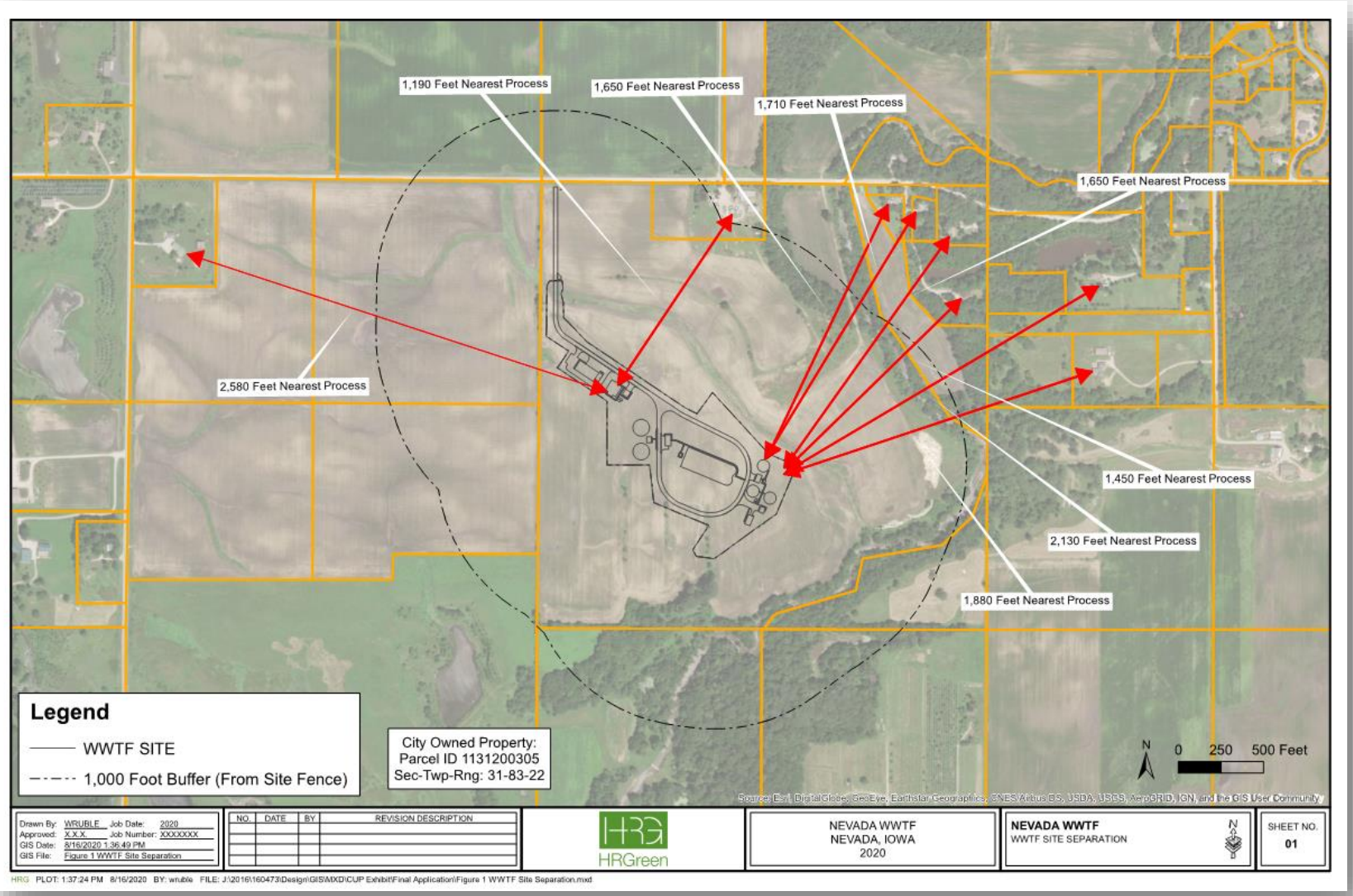


Figure 1: WWTF Site Separation Map

The proposed WWTF will not be unsightly, obnoxious, nor offensive in appearance to abutting or nearby properties. Another major benefit to the WWTF site location is its ability to screen the proposed WWTF from view of adjacent properties. The natural site grade allows for the facility to be built on a natural slope. This natural slope will allow the majority of the facility to be built below the natural line of site from properties to the north and west. To assist with visual screening, landscaped berm(s) are proposed to be constructed to the north of the site to provide screening from 270th Street. Other landscaped berm(s) are proposed to be constructed on the west side of the site to provide screening from the west properties and County Road S14. The southwest side of the site is abutted by the Jennet Heritage Area which serves as a public hunting area owned by Story County. This property serves as another visual barrier to privately owned properties. The south and east sides of the property are abutted by West Indian Creek which serves as both a physical and visual barrier to adjacent properties due to the established tree line that has formed around the floodplain. The site will also follow all applicable Story County development standards. The combination of visual screening and adherence to development standards will ensure a facility that will not be unsightly to nearby properties. See **Figure 2** below for a site plan showing visual screening from adjacent properties.

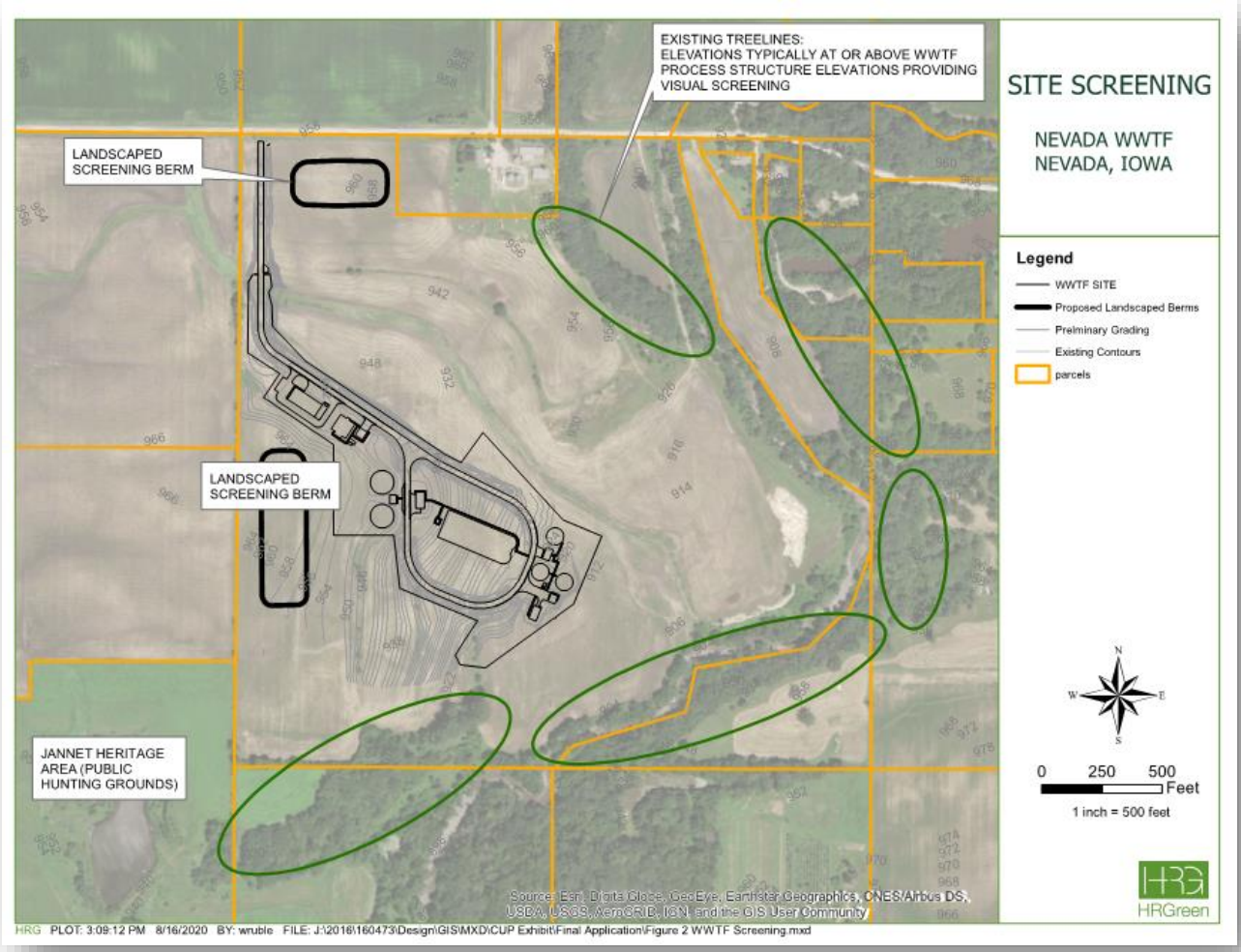


Figure 2: Site Screening

2.2. Transition

As previously stated, the WWTF site and location is designed to provide both visual and physical barriers from adjacent properties. The facility maintains maximum separation distances possible from inhabitable structures following IDNR regulations. In addition to visual, physical, and distance barriers to adjacent properties, the areas outside the physical WWTF on the site are planned to be planted with native grasses and landscaping. This will provide a visually appealing buffer between the facility and adjacent properties.

2.3. Traffic

The WWTF development will provide adequate ingress and egress to the site. The site will include a single entrance location from 270th Street. The entrance drive is located approximately 900 feet from the nearest driveway with a line-of-site exceeding the required 500 feet in each direction. The entrance drive will have a security gate that will control access into and out of the facility. This gate is anticipated to remain open during normal business hours. A security camera will be placed at the entrance gate so plant staff can monitor access. A gravel pull off will be located outside of the entrance gate so vehicles may turn around should they attempt to enter the facility after hours. There will also be controlled access via a card access system at the gate for operators or contractors. The gate can also be opened remotely by operators to let visitors enter the facility should the gate be closed. Provisions will be made at the entrance gate to allow emergency vehicle access at all times. The entrance drive will circulate traffic directly past the facility's Administration Building where visitor and employee parking will be located.

After passing the Administration Building, the entrance drive will split into a "loop road" that will circulate traffic around the facility in an oval orientation. The entrance drive and loop road will be a 24' wide, 7" thick portland cement concrete road designed to be able to circulate tanker trucks and emergency vehicles. The road will have a maximum grade of 5% to allow adequate circulation of the design vehicles. A speed limit of 15 mph will be posted before the loop road for the protection of pedestrians and vehicles. The entrance and loop road will serve as emergency and fire access to all site structures. The design has been reviewed for compliance with the International Fire Code by the City of Nevada's Fire chief. See **Figure 3** on the following page for the site paving plan.

The proposed WWTF is not anticipated to increase traffic greatly along 270th Street. See **Appendix C** for projected traffic volumes of the proposed WWTF.

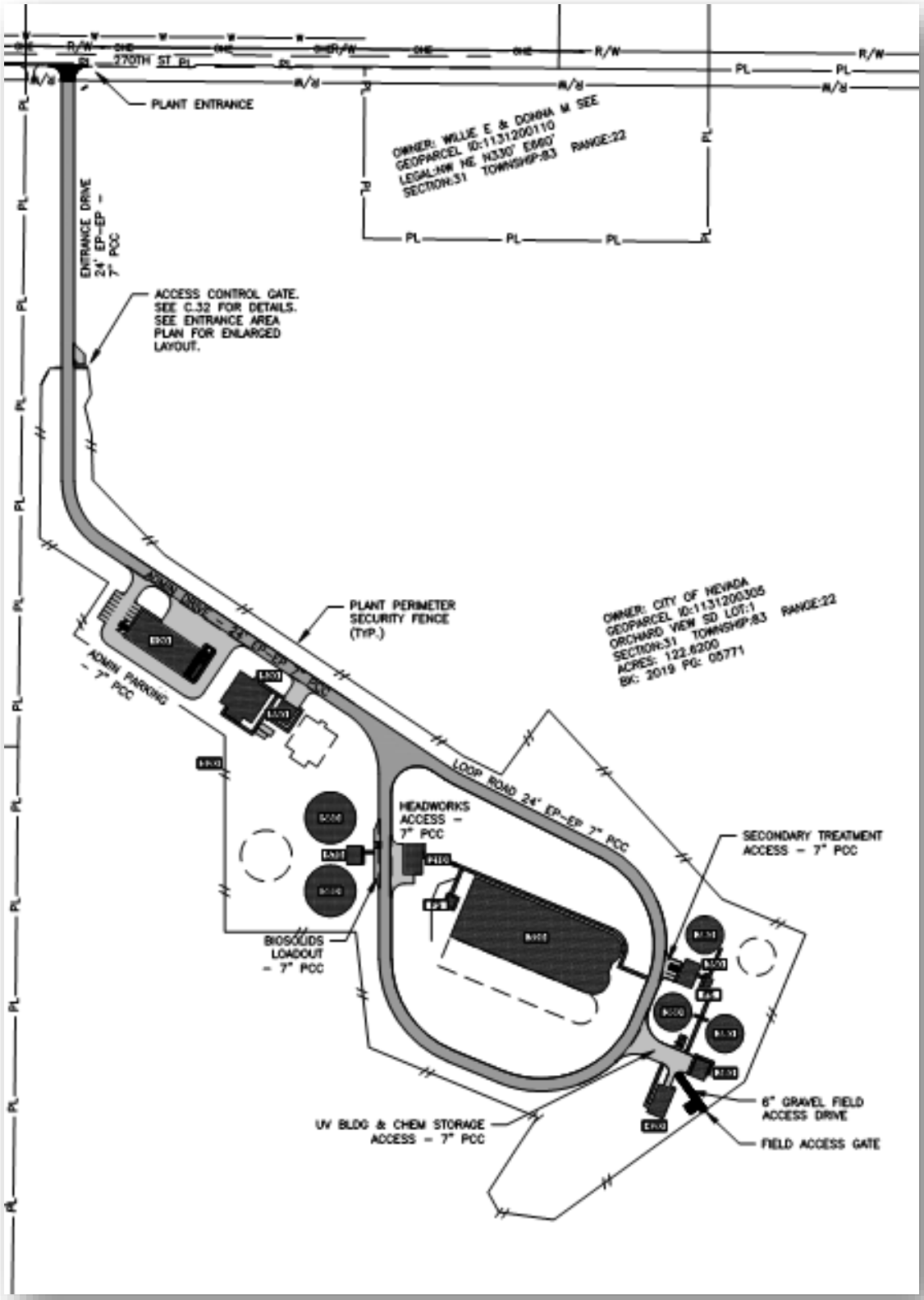


Figure 3: Site Paving Plan

2.4. Parking and Loading

A single designated parking lot will be provided at the Administration Building for employee, visitor, and accessible parking. At minimum one (1) van accessible parking space will be provided in accordance with American Disabilities Act regulations. At minimum, an additional ten (10) parking spaces will be provided for visitor and employee parking. There is no parking ratio designation for wastewater treatment facilities in Story County's Code of Ordinances, so it was assumed "Manufacturing Plants" to be a reasonable and similar designation. Manufacturing plants require one (1) parking space for every three (3) employees on the largest working shift. The proposed WWTF is anticipated to have four (4) employees on site during the largest shifts. The proposed ten (10) parking spaces should be more than sufficient based on this criterion.

Each remaining building will have a driveway for employee, contractor, or delivery access. These driveways will also serve as access for emergency and fire vehicles. These site buildings are only intended for employee, contractor, and delivery use and thus the driveways will not be designated as parking lots.

Per Story County regulations, a minimum of three (3) trees will be planted at the Administration Building parking lot to comply with the requirement of one (1) tree planted for every ten (10) parking spaces. These trees will be planted along the west side of the parking lot and will also serve as a screening barrier.

The total impervious area on site is approximately 3.4 acres. According to Story County Regulations an equivalent to 20-percent of a site's impervious surface must be planted as landscaped area. As previously stated, all disturbed areas of the site outside of the wastewater treatment facility will be restored to native vegetation. This area will account for greater than 20-percent of the sites impervious surfaces as landscaped area.

2.5. Signs and Lighting

A single landscaped monument sign will be located at the plant entrance to display the site as the City of Nevada's Wastewater Treatment Facility. The proposed sign's surface area will equal 32 square feet to meet the A-1 Zoning limitation. The sign will be lit by a single ground mounted flood light directed at the monument sign to provide visual aid to employees and visitors. See drawing C.33 of the "Phase 2" construction documents for a detail of the proposed sign.

Site lighting will comply with all requirements of Section 88.09 of Story County's Code of Ordinances. A single light pole will be located beside the plant entrance drive, just inside of the property line, to light the plant entrance off 270th Street. Site lighting poles will be placed along the plant's entrance drive from the security gate up to the Administration Building to provide safe access for employees. Site lighting poles will also be placed in the parking area west of the Administration Building, the access drive north of the UV Building, and at the south plant entrance gate. The three clarifier tanks and two biosolids storage tanks will have light poles mounted on top of them. Each building will also have building mounted exterior security lights. See **Figure 4** on the following page for the overall site lighting and power plan. Additional drawings are provided in the "Phase 2" construction documents.

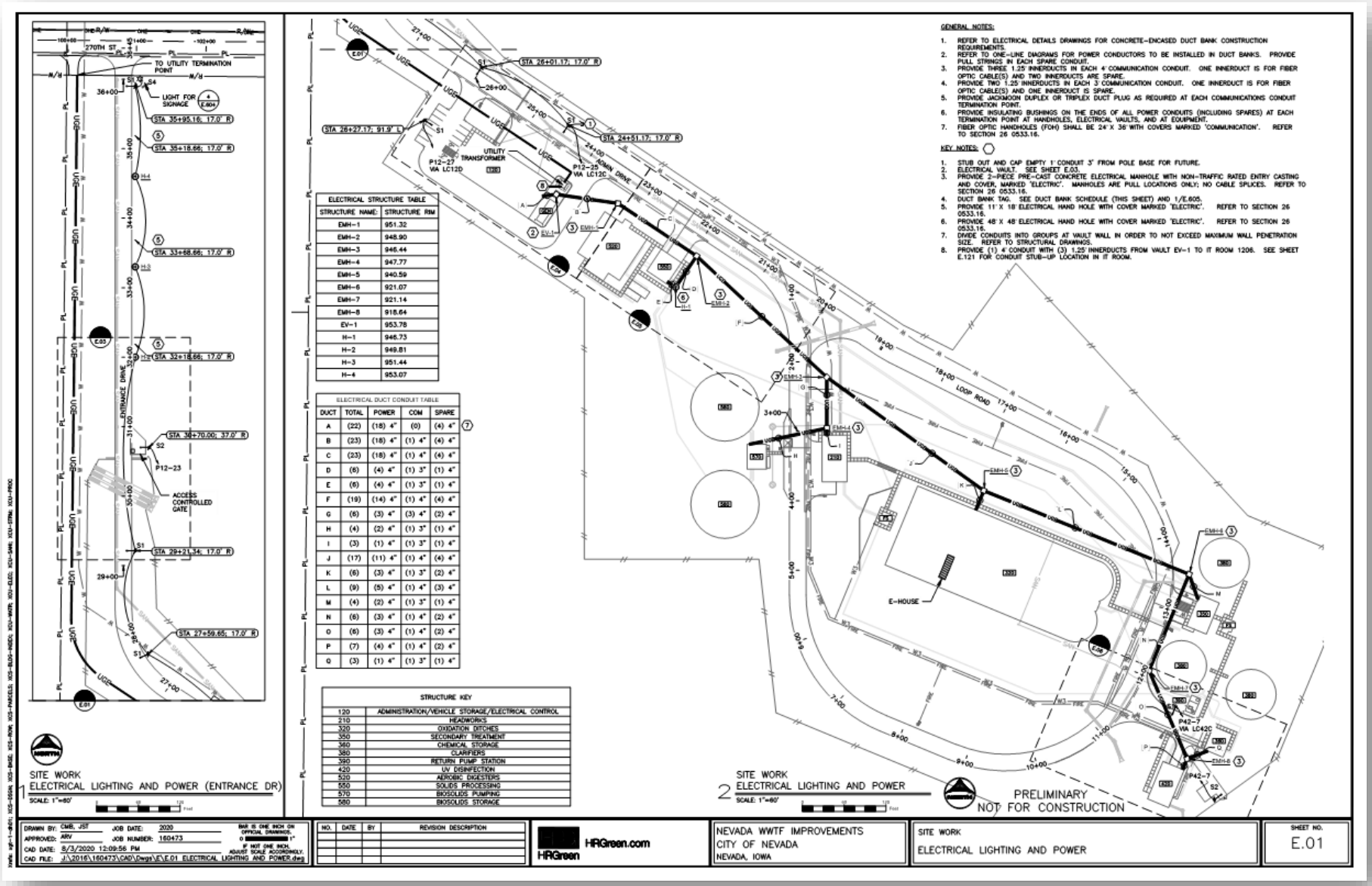


Figure 4: Site Lighting Plan

2.6. Environmental Protection

The proposed WWTF is designed and operated in such a manner that environmental and visual resources will be safeguarded. The treatment facility will be located on property that is currently being farmed as row-crops. As such, there will be little to no environmental impact due to the construction of the WWTF. The disturbed site area that will not be part of the WWTF will be restored to natural vegetation. The WWTF design will also include storm water management practices to prevent erosion to the site and surrounding water bodies in compliance with Story County regulations. Further information regarding the storm water management and erosion control plans will be provided in the "Permitting and Development Compliance" section of this report. A wetland delineation of the site has been performed and found that no wetlands will be impacted for construction of this project. Story County's Code of Ordinances also requires that no more than 15-percent of the sites naturally occurring resources may be removed. See **Figure 5** for a map of the site plan and the site's naturally occurring resources, floodplain, and wetlands. Less than 15-percent of the site's naturally occurring resources will be impacted by the construction of the facility. Refer to **Appendix D** for the wetland delineation report.

The proposed WWTF will also follow all IDNR regulations and comply with all State and Federal guidelines regarding wastewater treatment and discharge. As previously mentioned, the Facility Plan for the WWTF has been reviewed and approved by the Iowa DNR. An Antidegradation Analysis has also been submitted and approved for the facility. The Waste Load Allocation (WLA) provides water quality-based permit limitations for the discharge of the treated wastewater into West Indian Creek. The proposed WWTF will have to comply with all discharge limitations as detailed in the WLA and subsequent discharge permit. The existing WWTF currently discharges into West Indian Creek. The proposed WWTF will provide a benefit to the environment as it will provide a higher level of treatment than what the existing facility provides and discharge several miles downstream of the current facility which will result in less total impacted stream length to West Indian Creek. The WLA is provided in **Appendix E**.

The proposed WWTF will not generate excessive noise, vibration, dust, smoke, fumes, odor, glare, groundwater pollution, or other undesirable or nuisance conditions.

The WWTF's largest noise contributors will be equipment used for the wastewater treatment processes (i.e. aeration blowers, standby emergency generator, and pumps). The site's aeration blowers and standby emergency generator will be in noise attenuating enclosures that will be required to keep noise below specified thresholds. All pumps will be located within site buildings and structures that will contain/mitigate noise. Other exterior located equipment, equipment motors, and typical facility operations will not generate excessive noise. In general, the site will not generate any noise more than what would be expected in a typical A-1 Agricultural zone.

The facility will not generate any vibration, dust, or smoke except during construction activities. Construction activities will obtain all necessary permits as required at local, state, and federal levels.

As previously stated, the WWTF will follow all Story County regulations regarding site lighting. As such, the site will not create an excessive amount of glare.

The site's piping, tanks, and structures are designed according to applicable codes and standards. All wastewater will be contained throughout the treatment process and will not result in any impact to existing groundwater. As previously stated, the treated effluent to be discharged into West Indian Creek will meet all discharge limitations and will provide an increased level of treatment as compared to the existing wastewater treatment facility. On-site chemicals are stored inside an enclosed building with containment areas each providing 110-percent of the stored chemical volume. There will be two (2) chemicals stored in bulk on-site for the treatment of the wastewater as necessary. Both chemicals, ferric chloride and a carbon supplement (Micro-C), are non-hazardous. These chemicals should not pose any risk to the existing groundwater.

As with any wastewater treatment facility, there will be odor on the facility site. This odor has been mitigated during the design by choosing methods and processes that are known to reduce odor or produce less odor.

The largest odor producing process in wastewater treatment is from the treatment of the raw sewage. The raw sewage in the proposed WWTF will be treated through screening and grit removal in the Headworks building. Screening is the process of removing inorganic material from the wastewater such as rags, paper, plastic, metals, and other debris. Grit removal is the process of removing finer, largely inorganic, particles from the wastewater. The removed grit material will have a similar consistency to sand. The grit removal and screening will occur within the enclosed headworks building to contain the odor of the raw wastewater influent. The screened waste will be washed to remove organics and also help reduce odor while it is stored. It will be stored in dumpsters within the headworks building until disposal. The grit will also be washed to remove organics and reduce odor. The grit will be conveyed and stored on a covered pad outside of the headworks building. As the grit is inorganic and washed, it will be relatively odorless.

The screened raw wastewater will then be treated for organic and nutrient removal through an extended aeration process using a dual Oxidation Ditch layout. This process involves aerating and mixing the wastewater to allow microorganisms to remove organics and nutrients from the wastewater. The aerated treatment process minimizes odors while treating wastewater. The process is designed to have adequate detention times for constituent removal without allowing for the formation of odor-causing compounds (e.g. hydrogen sulfide) due to excessive detention time in the process.

Once the wastewater has been treated for nutrient and organic removal, the remaining solids are settled out as "sludge" in clarifiers before the treated wastewater is sent to the UV building for disinfection. These last two processes are known to be odorless as the organic material has been removed. The "sludge" that was settled in the clarifiers is typically treated through anaerobic or aerobic digestion. This facility will use aerobic digesters for the treatment of the waste sludge. Aerobic digestion is completed in an environment that limits the formation of odor-causing compounds. As such, the process is relatively odorless.

Additionally, the aerobic digestion process will incorporate covers over the tanks which will provide a secondary benefit of containing the minimal amount of odors produced during digestion. Once the sludge has been treated, the stabilized liquid material it is stored in large tanks and eventually applied to farm fields as a liquid fertilizer.

With the use of design considerations as described above, this WWTF will not produce excessive odor. The facility will not generate odor more than what would be expected of the current site or surrounding sites as an Agricultural use.

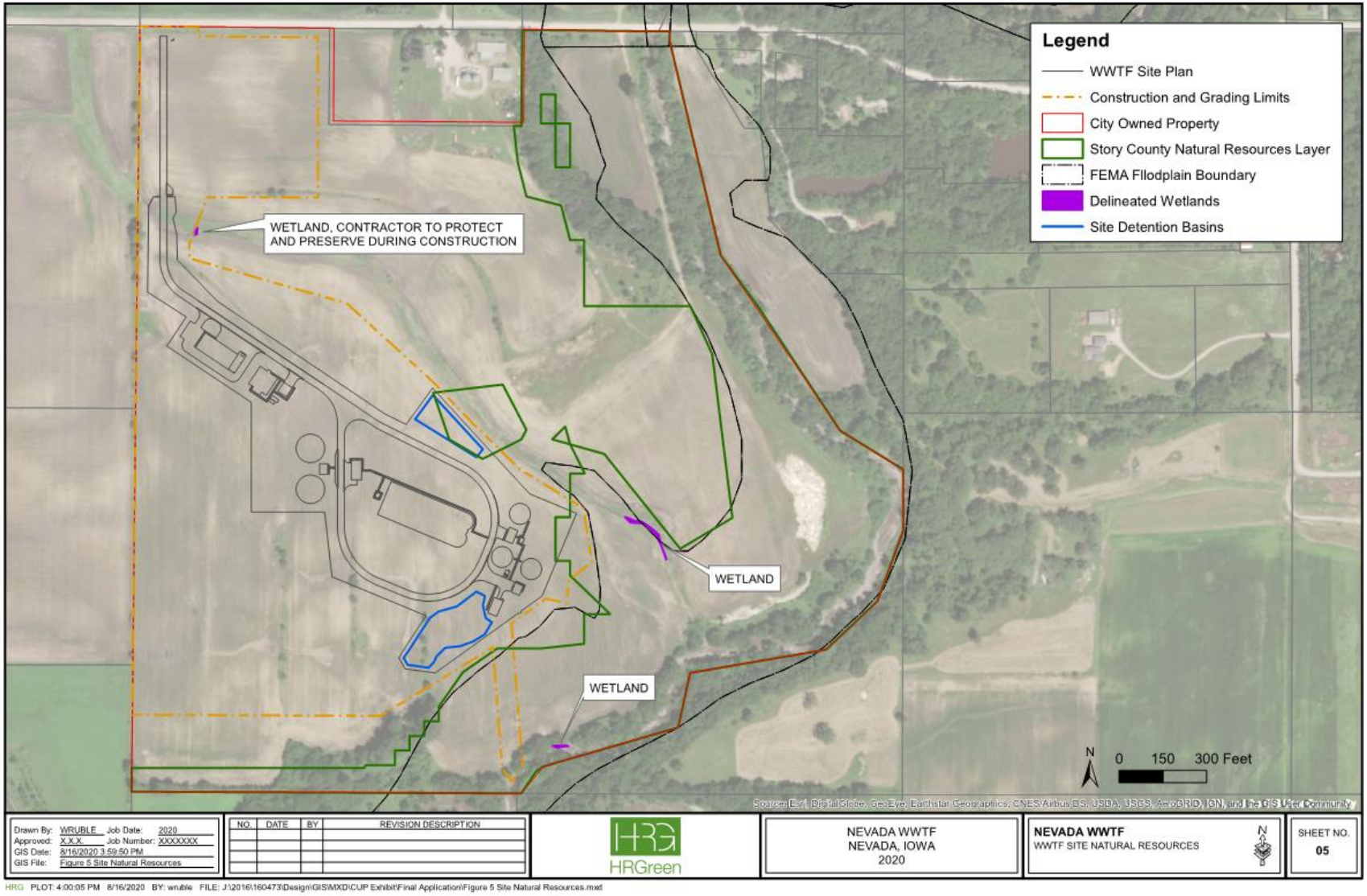


Figure 5: Site Natural Resources

3. PERMITTING AND DEVELOPMENT COMPLIANCE

3.1. Joint Application and Environmental Review

As this project will be SRF funded, it is undergoing an Environmental Review through the IDNR. This review includes a site survey, archeological survey, preparation of an Environmental Information Document (EID), and a public hearing to receive a "Finding of No significant Impact" certification for the proposed site. Currently, the environmental review has provided a preliminary approval from the site survey and completed the archeological survey. These documents can be found in **Appendix F**.

The project will also be performing construction activities within West Indian Creek's floodplain to construct the sites effluent outfall sewer into West Indian Creek. As such, a joint application has been submitted which will require approval from the IDNR Floodplain and Sovereign Lands divisions and the US Army Corps of Engineers. This application was submitted on August 14, 2020 and is currently under review.

3.2. Story County Floodplain Permit

Due to the construction of the effluent outfall sewer within the floodplain of West Indian Creek, a Story County Floodplain Development Permit will be required. The effluent outfall sewer consists of the construction of a 30-inch sewer to discharge treated plant effluent into West Indian Creek. A portion of the 30-inch sewer and the outfall structure will be located within the floodplain. The effluent sewer will be constructed of reinforced concrete pipe to combat uplift forces due to buoyancy during flooding events and combat external pressures due to soil movement due from thermal expansion and contraction. The outfall structure will consist of a concrete flared end section and a rip rap apron to dissipate the effluent flow energy prior to discharge into West Indian Creek. Rip Rap protection will be placed along West Indian Creek's bank upstream and downstream of the outfall. Vegetation such as potted plugs and live stakes may also be utilized to stabilize the bank and reduce energy from the sewer outfall. See Phase 1 construction documents for a plan and profile of the proposed outfall and details.

The floodplain permit will be submitted after acceptance of the conditional use permit. Only activity associated with installation of the effluent outfall pipe will occur within the floodplain.

3.3. Stormwater Management and Erosion Control

The proposed WWTF will follow all Story County regulations regarding stormwater management and Erosion Control.

As the proposed WWTF site will disturb greater than one (1) acre of land, a stormwater NPDES permit will be required. The required Stormwater Pollution Prevention Plan will be prepared for and signed by HR Green as part of the construction documents. Stormwater management will be the construction contractors' responsibility during each phase of construction. Each contractor will be responsible to uphold the NPDES permit and stormwater pollution prevention plan. Preliminary erosion control site plans can be found in the construction

documents. A preliminary copy of the stormwater pollution prevention plan can be provided upon request.

The WWTF will follow all drainage and discharge requirements as required under Story County's Code of Ordinances Chapter 88. A stormwater management plan will be developed per these requirements as the facility will disturb one (1) or more acres of land. A draft of the sites storm water management plan is provided in **Appendix G.**

3.4. Construction Permits

All applicable permits for construction including Iowa DNR Schedules A, F, and G will be completed and submitted with final documents to Iowa DNR prior to any construction activities taking place on site.

3.5. Fire Protection

The proposed WWTF will meet all requirements of the International Fire Code (IFC) as determined to be applicable by the City of Nevada Fire Chief who will serve as the site's Authority Having Jurisdiction (AHJ). The site will utilize plant effluent water to provide fire protection water throughout the site. Hydrants are spaced throughout the site meeting requirements of the International Fire Code. The Administration Building and Chemical Storage Building require sprinkler protection according to guidelines from the IFC and National Fire Protection Agency (NFPA). The AHJ has determined the Chemical Storage Building will not require sprinkler protection as it does not house any hazardous chemicals and has written a variance. See **Appendix H** for the approval letter and variance from the AHJ regarding the site fire protection system.

4. CONSTRUCTION PHASING

4.1. Schedule and Programmatic Agreement

Design and construction of the WWTF and Trunk Sewer will be divided into several construction phases due to the large scale of the construction project. The City, Iowa DNR, and HR Green are developing a Programmatic Agreement (PA) for the project permitting and construction. The PA will lay out a phased construction schedule for construction of the WWTF and conveyance system (lift station, force main, & trunk sewer) between the existing and proposed WWTFs. This PA is necessary to provide compliance with regulatory requirements for environmental reviews and issuance of clearances (FONSI) to allow for construction of the improvements. The use of a PA will facilitate an accelerated construction schedule and completion of the proposed improvements. The draft PA schedule for proposed improvements is given below:

Phase	Title	Description of Work Included	Begin Construction	Complete Construction
1	Wastewater Treatment Facility (WWTF) Site Grading	• Earthwork (cut/fill) for changing site topography for subsequent construction of WWTF infrastructure (tanks, buildings, etc.) • Construction of site access driveway from 270th Street to south of existing drainage ditch, including installation of stormwater culverts under the site access driveway • Construction of influent trunk sewer pipe and manholes within the WWTF site boundaries • Construction of effluent outfall sewer pipe and manhole	November 2020	March 2020
2	WWTF Improvements	• Construction of WWTF treatment structures and buildings, yard piping, site utilities (potable water, non-potable water, electric, natural gas, communications); final site grading; landscaping; paving of access driveways and parking areas	July 2021	November 2023
3	Trunk Sewer and Main Lift Station	• Construction of main influent sewage lift station at the existing WWTF site • Construction of main influent sewer lift station force main from lift station to start of trunk sewer • Construction of 24-inch/30-inch diameter sanitary sewer gravity interceptor piping and related manholes to the WWTF site	January 2022	November 2023

4.2. Phase 1 & 2 WWTF Construction

The WWTF construction is proposed to be completed in two phases: (1) Site Grading Phase and (2) A WWTF Construction Phase. The purpose of the separate construction contracts of the WWTF is to accelerate the construction timeline, limit sub-contractor coordination, and encourage a more competitive bidding environment for resident bidders.

Phase 1 and 2 is covered under one environmental review effort. Related permitting and clearances will cover Phase 1 and 2 activities. Separate Iowa DNR Construction Permits will be obtained for Phase 1 and 2 construction. All required permits will be obtained prior to giving notice to proceed on construction activities.

4.2.1. Phase 1: Grading Phase

Site grading is planned to begin this fall (2020) once all permitting requirements are approved. The grading phase of the project will include rough site grading to balance the site's cut and fill, construction of the entrance drive's triple 54 inch drainage culvert, construction of the influent trunk sewer located on the City of Nevada's property, and construction of the effluent outfall sewer.

Bidding this work as a separate contract will allow the City to accelerate project construction versus waiting to begin this work in Spring 2021.

4.2.2. Phase 2: WWTF Construction Phase

The construction of the remaining portion of the WWTF will take place under the Phase 2 contract. This contract is expected to be awarded in Spring of 2020 and commence immediately following the completion of the Phase 1 grading contract.

With the rough site grading completed over the previous fall construction can begin in Spring 2021.

4.3. Trunk Sewer Construction

Final design and construction of the trunk sewer will take place following the completion of the Phase 2 WWTF design for the following reasons:

1) The Iowa DNR environmental review of the trunk sewer will take additional time that would delay project construction if included as part of the WWTF construction contract.
2) Complete design and construction of the trunk sewer will take less time than the construction of the WWTF.

The Iowa DNR has given verbal approval for this methodology through the PA.

Preliminary alignments of the proposed trunk sewer are provided with this application. The trunk sewer contract will consist of the construction of a new lift station at the existing WWTF to convey flows via a force main up to the intersection of SW 3rd Street and Maple Avenue. The force main will follow the south side of U.S. Highway 30 and the east right-of-way of SW 3rd Street before discharging to a receiving manhole and flowing by gravity the remainder of the

way to the proposed WWTF. The Gravity sewer will follow the right-of-way of SW 3rd Street/County Road S14 the majority of the way to the new WWTF. The sewer will cross County Road S14 with trenchless construction as needed to avoid utilities. The final segment of the sewer will be constructed within easements on private property (existing farmland) to avoid deep bury conditions at the intersection of County Road S14 and 270th Street. The sewer will cross 270th Street with trenched construction if allowable and tie into the influent trunk sewer to be constructed during the Phase 1 construction contract.

Work related to temporary and permanent easement acquisition is planned for Spring of 2021. The trunk sewer design will be completed and bid for construction Fall of 2021. This will allow adequate time for construction of the trunk sewer to be completed prior to the completion of the of WWTF construction contract.

5. PROJECT BENEFITS

Construction of the new WWTF will have multiple benefits to the surrounding community including:

1) Improves opportunity for redevelopment of existing WWTF site
2) Higher level of wastewater treatment
3) Increased capacity for planned industrial growth
4) Capacity for projected 20-year residential and industrial growth
5) Sufficient expansion capability for growth beyond 20-years
6) Capability to connect future developments along County Road S14 to the Influent Trunk Sewer

With the existing wastewater treatment facility nearing the end of its design life, the expansion of a Significant Industrial User and subsequent increased loadings to the WWTF, and more stringent treatment regulations a new WWTF is a necessity for the City of Nevada. The proposed WWTF will also have the additional benefits that will serve the surrounding community for many years to come.

A. Appendix A – 1,000 ft Site Separtion Property Owner Certification

PURCHASE AGREEMENT FOR REAL ESTATE

This Purchase Agreement for Real Estate ("Agreement") is entered into on this 23rd day of January, 2017, between **Willie E. See** and Donna M. See ("Seller"), and **City of Nevada, Iowa** ("Purchaser"). Seller and Purchaser shall be collectively referred to herein as (the "Parties"). In consideration of the mutual covenants set forth in this Agreement and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Seller and Purchaser agree as follows:

1. **PROPERTY**
   Purchaser agrees to purchase from the Seller and the Seller agrees to sell to Purchaser the following described real property:

   See Exhibit B

   which property, in the aggregate, contain approximately 123.50 acres of real estate, which is further depicted on Exhibit A attached hereto and legally described in Exhibit B attached hereto (the "Property").

2. **PURCHASE PRICE.** The Purchaser agrees to purchase the Property for the purchase price of $7,500.00 per acre, for the total purchase price of $926,250.00 (the "Purchase Price.") The Purchaser shall pay the full amount of the Purchase Price on the date of Closing.

3. **EVIDENCE OF TITLE**
   Within ten (10) days after the execution of this Agreement, Seller shall deliver to Purchaser the abstract of title to the Property. The Purchaser agrees to pay for the costs associated with the updating the abstract. The abstract shall show merchantable title in Seller in conformity with this Agreement, Iowa Law, and Title Standards of the Iowa State Bar Association. The abstract shall become the Property of Purchaser when the Purchase Price is paid in full.

4. **CONVEYANCE OF TITLE**
   Upon payment by Purchaser of the Purchase Price for the Property, Seller shall convey the Property to Purchaser by a Warranty Deed subject to easements and restrictions of record.

5. **CONDITIONAL USE PERMIT, POSSESSION AND CLOSING**
   The Purchaser's obligation to purchase the Property shall be contingent on (i) the Plat of Survey being successfully recorded and (ii) the Purchaser, with the assistance of Seller, obtaining a conditional use permit ("CUP") for the intended use. To that end, upon execution of this Agreement, the Purchaser shall prepare the requisite conditional use application, which application shall be executed by the Seller. The Purchaser shall then submit the application for review of the Story County Planning and Zoning Commission and Board of Adjustment.

   After receipt of the CUP, Seller shall deliver possession of the Property to Purchaser concurrently with the closing of this transaction, which shall be held on or before thirty (30) days after the approval of the CUP ("Closing"). At Closing, Purchaser shall deliver the Purchase Price to the Seller.

6. **PRORATIONS AND ADJUSTMENTS**
   The following items shall be prorated at closing as of the date of delivery of possession:

   N/A: Purchaser agrees to cover all prorations and adjustments.

7. **TAXES AND SPECIAL ASSESSMENTS**

Seller shall pay all real estate taxes that are liens for prior years, and the Purchaser shall pay for all prorated real estate or ad valorem taxes for the current tax fiscal year which may not be due and payable until after Closing. All subsequent real estate or ad valorem taxes shall be paid by Purchaser.

Seller shall pay in full all special assessments, which are certified as liens on the subject Property as of the date of closing. All other special assessments shall be paid by Purchaser.

8. CONDITION OF PROPERTY

The parties agree that the Purchase Price reflects the condition of the Property and Purchaser acknowledges that the real estate and improvements thereof have been inspected, and Purchaser is acquainted with the condition thereof and accepts the same in:

"As Is" condition except Seller warrants that the following items will be completed prior to Closing:

1. N/A

9. ENVIRONMENTAL

Purchaser, at its cost, shall have the right to perform environmental testing which must be completed prior to Closing.

10. SURVEY

Purchaser may obtain a current survey of the Property prepared, at Purchaser's expense, by a duly licensed land surveyor conforming to customary local certification requirements ("Purchaser's Survey"). If Purchaser's Survey shows any matters adversely affecting title, such matters shall be deemed a title defect.

11. FARMING OF PROPERTY

The Parties agree that, as part of the consideration for the sale of the Property, the Seller or their designee shall be allowed to farm the Property, with no rental cost assessed to the Seller, until such time as the Purchaser provides notice of termination. It is acknowledged that the farming lease will not exceed a period of five (5) years, unless such time is renegotiated between the Parties. In the event of termination, the Purchaser shall provide notice of termination in accordance with Iowa Code §562.7, on or before September 1st of the relevant year prior to the beginning of any construction.

All crop production expenses and expenses for fence and building repairs shall be responsibility of the Seller. In farming the Property, the Seller agrees to take no actions that might cause a mechanic's lien or other lien to be imposed upon the Property. The Seller further agrees to farm the Property in an efficient and steward-like manner, control weeds and brush in the fields, fence rows, and road ditches, provide proper maintenance to control erosion and maintain terraces, waterways and tiles on the Property.

In the event Seller elects to farm the Property, the Purchaser shall be allowed the right to enter the premises at any time for any reasonable purpose.

12. DISTANCE WAIVER

The Parties acknowledge that the Seller will continue to own an inhabitable single-family residence on a parcel adjacent to the Property. Furthermore, the Parties understand that the Purchaser's proposed improvements on the Property will include construction of a wastewater treatment system, which will be nearer than 1,000 feet to said single family residence. The Seller hereby agrees to execute a Distance Waiver, in substantially the same form as Exhibit C, attached hereto, which document shall be filed with the Story County Recorder. Seller further agrees that any future sale of the parcel containing the single-family residence shall be subject to and conditioned upon any purchaser executing a subsequent Distance Waiver as needed.

13. RIGHT OF FIRST REFUSAL

The Parties hereby agree that the Purchaser shall have the right of first refusal to purchase the parcel of land containing Seller's homestead, which is locally known as _____ (the "Homestead"). Thus, before Seller may sell the Homestead to a third party, Seller shall first offer the Homestead to Purchaser on the

same terms and conditions as are offered by the third party. Purchaser shall have 30 days during which to accept said offer. If Purchaser does not accept said offer within said period, Seller shall be free to accept the third-party offer. If Seller does not enter into an agreement with the third party on said terms and conditions and close the transaction within 90 days, Seller's right to sell the Homestead to the third party shall expire and the procedure described in this section shall again be applicable.

14. DEFAULT

If Purchaser fails to make any payment or to perform any obligation imposed upon Purchaser by this Agreement, Seller may serve written notice of default upon Purchaser and if such specified default is not corrected within ten (10) days thereafter, Seller, subject to the terms of any listing agreement, may accept the Earnest Money as damages or may pursue any available legal remedy including specific performance.

In the event Seller fails to perform any obligation imposed upon Seller by this Agreement, Purchaser may serve written notice of default upon Seller and if such default is not corrected within ten (10) days thereafter, Earnest Money shall be refunded to Purchaser without prejudicing the Purchaser's right to any available legal remedy including specific performance.

In the event of default, the defaulting party shall be liable to the other party for reasonable attorney fees, expenses incurred by reason of default, and the real estate brokerage fee.

15. CASUALTY CLAUSE

Seller shall bear the risk of loss and damage to the Property prior to closing or possession, whichever first occurs. In the event all or a material part of the Property is damaged or destroyed prior to closing or possession, whichever first occurs, this contract shall terminate and be of no further force and effect, unless the Property can be restored to its present condition on or before the closing date. Purchaser shall be responsible for insurance coverage upon taking title to or possession of the subject Property, whichever occurs first.

16. EXPENSES OF TRANSFER

A. Purchaser shall pay:

(1) Abstracting fees to update abstract.
(2) Recording fee for deed and mortgage
(3) Transfer tax.
(4) Cost of any Survey.

Each Party shall be responsible to pay its own legal fees and costs incurred in connection with the transaction.

17. REPRESENTATIONS OF SELLER – HAZARDOUS WASTE

Seller hereby represents to Purchaser that, to the best of Seller's knowledge, the subject Property is not contaminated with, nor threatened with contamination from outside sources by, any chemical, material or substance to which exposure is prohibited, limited or regulated by any federal, state, county, local or regional authority or which is known to pose a hazard to health and safety and that Seller has not used the subject Property as a landfill or dumpsite, or for storage of hazardous substances, or has not otherwise done anything to contaminate the subject Property with hazardous wastes or substances. Seller warrants that the subject Property is not subject to any local, state or federal judicial or administrative action, investigation or order, as the case may be, regarding wells or underground storage tanks, solid waste disposal sites, or hazardous wastes or substances.

At Purchaser's cost, Purchaser shall be permitted to conduct any environmental tests it deems necessary for the purpose of discovering the existence of any hazardous waste or substances. Should such environmental testing reveal the presence of any hazardous wastes or substances, Purchaser may, at its option, terminate this Agreement and any Earnest Money paid shall be returned to Purchaser. Purchaser agrees, at its cost and without undue delay, to restore the subject Property to its original condition should it proceed with the environmental testing contemplated herein.

18. LEASES

As of the date of this Agreement, the subject Property is subject to the following leases: None.

19. NOTICES

All notices required hereunder shall be in writing and shall be served upon the parties at the addresses designated herein by personal service, certified mail (return receipt requested), or Federal Express or other overnight mail.

Seller:
Willie E. See
Willie E See

_____

Purchaser:
City of Nevada
c/o City Administrator
1209 6th Street
Nevada, Iowa 50201

20. GENERAL CONDITIONS

This Agreement shall be binding upon the parties and their successors and assigns. Time is of the essence of this Agreement. This Agreement shall be governed by and enforced in accordance with the laws of the state in which the subject Property is located. This Agreement contains the entire agreement of the parties and no representations, warranties, or agreements have been made by either party as set forth herein. No modification, waiver, or amendment of the Agreement shall be effective unless made in writing and signed by the parties. All representations, warranties and covenants made by the parties shall survive closing. Paragraph headings are for the convenience of reference and shall not limit or affect the meaning of the Agreement.

21. OTHER PROVISIONS

(1) Seller shall provide Purchaser any documents and/or material in Seller's possession relating to the value, use, soil condition, environmental quality, survey, special assessments, zoning, association documents or proposed condemnation and all leases affecting the Property, if any.

22. LEGAL ASSISTANCE

The Seller and Purchaser are aware that when fully executed, this is a legally binding agreement for the sale and purchase of real estate and that in order to protect their respective interests, Seller and Purchaser are advised to consult legal counsel before this Agreement is signed.

23. ACCEPTANCE BY SELLER

Until accepted by Seller, this document constitutes an offer by Purchaser on the terms stated above. This Agreement must be accepted by Seller in writing on or before **Monday, January 23, 2017** by no later than **5:00 p.m. CDT.** If not so accepted, the Offer shall be void.

24. CONFIDENTIALITY

The Parties agree that the terms of this Agreement are confidential and shall not be released to or shared with any other third party, whether verbally or in writing, without the prior written approval of all Parties (other than the Parties' attorneys, consultants, lenders and advisors who shall also be subject to confidentiality). No Party shall make any public announcement or carry out any publicity whatsoever in connection with this Agreement unless mutually agreed in writing. This confidentiality requirement shall survive termination of this Agreement in the event it is terminated by either Party and also survive the Closing of the transaction described in this Agreement except as to those matters which will appear of public record after the filing of the Warranty Deed for the Property by Purchaser.

Seller hereby accepts the foregoing offer this 23 **day of** Jan, **2017.**

SIGNATURE PAGE:

PURCHASER:

City of Nevada, Iowa

By: Lynn Hathrop

Its: Mayor

SELLER:

Willie E. See

By: Willie E See

Donna M. See

By: Donna M. See

EXHIBIT A

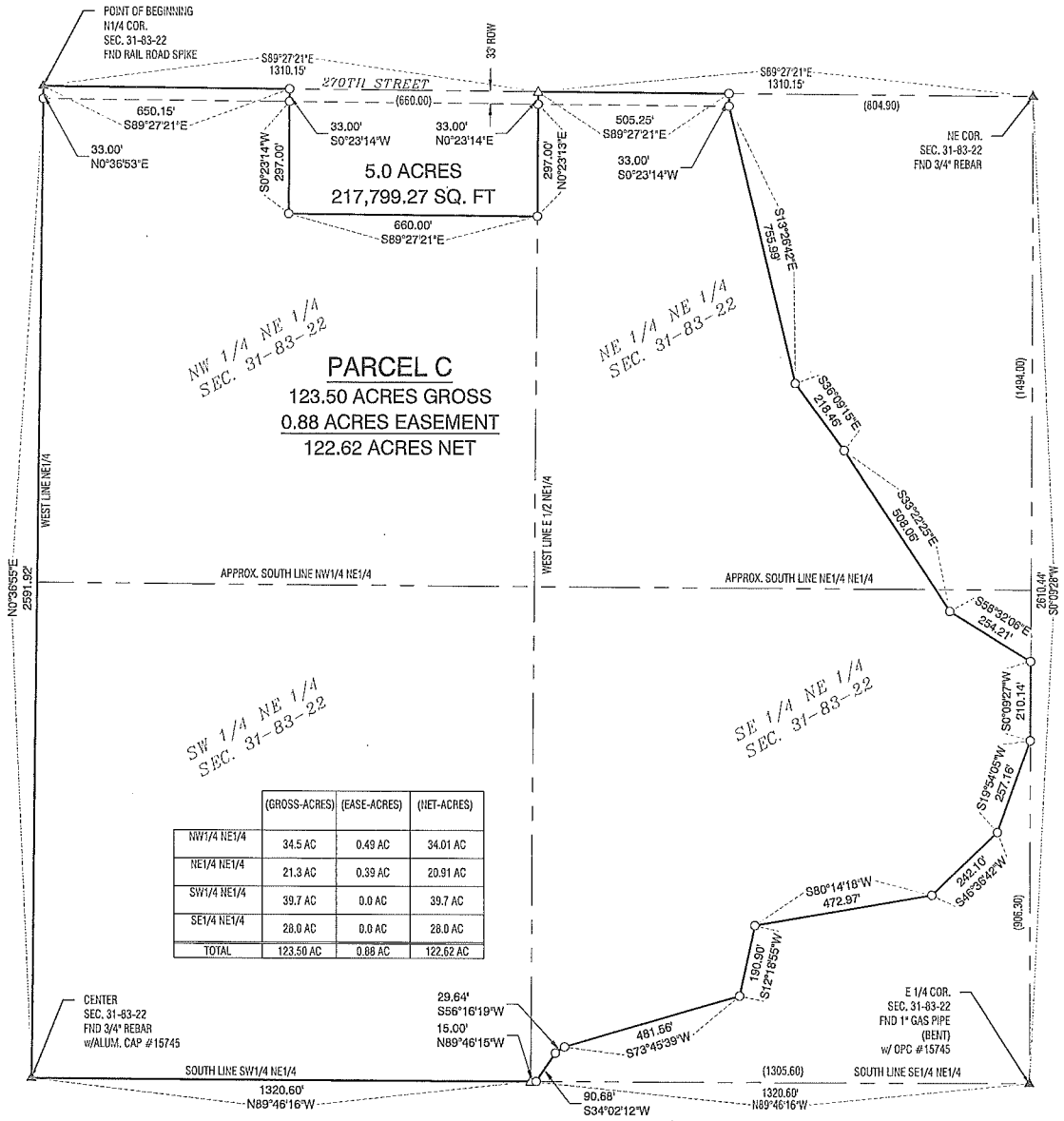
[INSERT ENGINEERING RENDERING OF PROPERTY]

EXHIBIT B

[INSERT LEGAL DESCRIPTION]

PLAT OF SURVEY

INDEX LEGEND	
LOCATION:	NE 1/4 SEC. 31, T83N, R22W ,5TH PM NEVADA TWP., STORY COUNTY, IOWA
PROPRIETOR:	WILLIE E & DONNA M SEE
SURVEY REQUESTED BY:	WILLIE E & DONNA M SEE
FIELD WORK COMPLETED:	12/29/2016
SURVEY PREPARED BY: RESPOND TO:	CLAPSADDLE-GARBER ASSOCIATES, INC, 16 EAST MAIN STREET, P.O. BOX 754, MARSHALLTOWN, IOWA 50158 PHONE 641-752-6701 TSTEWART@CGACONSULTANTS.COM



	(GROSS-ACRES)	(EASE-ACRES)	(NET-ACRES)
NW1/4 NE1/4	34.5 AC	0.49 AC	34.01 AC
NE1/4 NE1/4	21.3 AC	0.39 AC	20.91 AC
SW1/4 NE1/4	39.7 AC	0.0 AC	39.7 AC
SE1/4 NE1/4	28.0 AC	0.0 AC	28.0 AC
TOTAL	123.50 AC	0.88 AC	122.62 AC

PARCEL 'C' LEGAL DESCRIPTION:

A PARCEL OF GROUND LOCATED IN NORTHEAST ¼ OF SECTION 31, TOWNSHIP 83 NORTH, RANGE 22 WEST OF THE 5TH P.M., NEVADA TOWNSHIP, STORY COUNTY, IOWA. MORE PARTICULARLY DESCRIBED AS THE FOLLOWING: COMMENCING AND BEGINNING AT THE NORTH ¼ CORNER OF SECTION 31, TOWNSHIP 83 NORTH, RANGE 22 WEST OF THE 5TH P.M.; THENCE S89°27'21"E, 650.15 FEET ALONG THE NORTH LINE OF SAID SECTION 31; THENCE S0°23'14"W, 33.00 FEET; S0°23'14"W, 297.00 FEET; THENCE S 89°27'21" E, 660.00 FEET; THENCE N 0°23'13" E, 297.00 FEET; THENCE N 0°23'14" E; 33.00 FEET, THENCE S 89°27'21" E, 505.25 FEET ALONG THE NORTH LINE OF SAID SECTION 31; THENCE S 0°23'14" W, 33.00 FEET, THENCE S 13°26'42" E, 755.99 FEET; THENCE S 36°09'15" E, 218.46 FEET; THENCE S 33°22'25" E, 508.06 FEET; THENCE S 58°32'06" E, 254.21 FEET TO A POINT ON THE EAST LINE OF SAID SECTION 31; THENCE S 0°09'14" W, 210.14 FEET ALONG THE EAST LINE OF SAID SECTION 31; THENCE S 19°54'05" W, 257.16 FEET; THENCE S 46°36'42" W, 242.10 FEET; THENCE S 80°14'18" W, 472.97 FEET; THENCE S 12°18'55" W, 190.90 FEET; THENCE S 73°45'39" W, 481.56 FEET; THENCE S 56°16'19" W, 29.64 FEET; THENCE S 34°02'12" W, 90.68 FEET TO THE SOUTH LINE OF THE NE ¼ OF SAID SECTION 31; THENCE N 89°46'15" W, 15.00 FEET ALONG SAID SOUTH LINE OF THE NE ¼, THENCE N 89°46'16" W, 1320.86 FEET ALONG SAID SOUTH LINE OF THE NE ¼ TO THE CENTER OF SAID SECTION 31, THENCE N 0°36'55" E, 2591.92 FEET ALONG THE WEST LINE OF THE NE ¼ OF SAID SECTION 31, THENCE N 0°36'53" E, 33.00 FEET ALONG SAID WEST LINE OF THE NE ¼ OF SAID SECTION 31 TO THE POINT OF BEGINNING. PARCEL 'C' CONTAINS 123.5 ACRES AND IS SUBJECT TO THE EASEMENTS AND RESTRICTIONS OF RECORD.

NOTE:
ALL BEARINGS ARE THE RESULT OF G.P.S. OBSERVATIONS.

LEGEND:

- ▲ GOVERNMENT CORNER MONUMENT FOUND
- △ GOVERNMENT CORNER MONUMENT SET 1/2" x 30" REBAR w/ORANGE PLASTIC ID CAP #17162
- ● PARCEL OR LOT CORNER MONUMENT FOUND
- ○ SET 1/2" x 30" REBAR w/ORANGE PLASTIC ID CAP #17162
- ( ) RECORDED AS

N

SCALE 1"=300'
0 300'

PLAT OF SURVEY

TRAVIS R. STEWART LICENSED 17162 IOWA PROFESSIONAL LAND SURVEYOR

I hereby certify that this land surveying document was prepared and the related survey work was performed by me or under my direct personal supervision and that I am a duly Licensed Professional Land Surveyor under the laws of the State of Iowa.

Travis R. Stewart, PLS date
Iowa License Number 17162
My License Renewal Date Is December 31, 2017
Pages or sheets covered by this seal: THIS SHEET

CGA

Clapsaddle-Garber Associates, Inc
16 East Main Street
Marshalltown, Iowa 50158
Ph 641-752-6701
www.cgaconsultants.com

DRAWN	SHEET NO.
RWA	1
DATE	PROJECT NO.
01-04-2017	77253.05

J:\77253\dwg\Survey\77253-Plat of Survey.dwg - Plat LEGEND - 01-04-17 - 2:54pm - rw236

Prepared by and Return to: City of Nevada, 1209 6th Street, Nevada, IA 50201 (515) 382-5466

DISTANCE WAIVER

The undersigned, being the record titleholder(s) to the real property located in Story County, Iowa, locally known as 62650 270th Street, Nevada, Iowa 50201, and legally described as follows:

See Exhibit A

(hereinafter the "Property"), which Property contains either an inhabitable single family residence or commercial business, acknowledged that the City of Nevada will be constructing a wastewater treatment facility on adjoining property. Furthermore, the undersigned acknowledges that the construction of the wastewater treatment system will be nearer than 1,000 feet to said single family residence or commercial business located on the Property.

567-64.2 (3) of the Iowa Administrative Code (I.A.C.) states, "The following separation distance from treatment or lagoon water surfaces shall apply: a 1,000 feet from the nearest inhabitable residence, commercial building, or other inhabitable structure. If the inhabitable or commercial building is on the property of the owner of the proposed treatment facility, or there is written agreement with the owner of the building, the separation criteria shall not apply. Any such agreement shall be filed with the county recorder and recorded for abstract of title purposes, and a copy submitted to the Department (Iowa Department of Natural Resources)."

In consideration of the sum of one dollar ($1.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned, in signing this DISTANCE WAIVER, hereby waives their rights to the separation criteria as set forth in 567-64.2 (3), and consents to the placement of a wastewater treatment facility to be constructed by the City of Nevada on the real property legally described as:

Lot 1 of the Orchard View Subdivision, an Official Plat, in Story County, Iowa.

Property described subject to any and all easements of record.

Furthermore, the undersigned acknowledges that the City has yet to determine the exact location of the wastewater treatment facility, but understands that the constructed facility will be located entirely within the area designated as the proposed site on the aerial photograph attached hereto as "Exhibit A". It is expressly agreed and understood that the waiver and consent given herein shall be applicable to the entire designated as the proposed site on "Exhibit A", with the

exact location of the wastewater facility to be determined by the City of Nevada from within the designated proposed site.

It is further agreed by the undersigned that upon final site selection by the city of Nevada, that the City may incorporate the legal description of the real property selected for the wastewater treatment plant into this DISTANCE WAIVER and such DISTANCE WAIVER will be filed with the county recorder and a copy submitted to the Iowa Department of Natural Resources. All costs associated with conveying and recording this DISTANCE WAIVER shall be paid by the City of Nevada.

Willie C See
Property Owner

Donna M. See
Property Owner

STATE OF IOWA)
)ss:
STORY COUNTY)

Subscribed and sworn to before me by Willie See and Donna See on the 7th day of June, 2017.

NOTARIAL SEAL IOWA
JODY LYNN ELDRIDGE
Commission Number 710090
My Commission Expires
5.22.19

Jody Lynn Eldridge
Notary Public in and for said State

EXHIBIT A

Outlot A and Outlot B of the Orchard View Subdivision, an Official Plat, in Story County, Iowa.

B. Appendix B – Adjacent Property Value Impact Analysis

C. Appendix C – Traffic Impact Analysis

HRGreen®

▷5525 Merle Hay Road | Suite 200 | Johnston, IA 50131
Main 515.278.2913 + **Fax** 515.278.1846

▷HRGREEN.COM

August 16, 2020

Darren Moon, P.E.
Story County Engineer
837 N Avenue
Nevada, Iowa 50201

Re: Nevada WWTF Improvements Conditional Use Permit – Historical and Projected Future Traffic

Dear Mr. Moon,

As discussed during the May 7, 2020 Conditional Use Permit Conceptual Review Meeting for the City of Nevada Wastewater Treatment Facility (WWTF) Improvements HR Green is providing the historical traffic data at the nearest intersection to the proposed Nevada WWTF site and the future average daily and weekly trips generated for the site. For the future projected WWTF site traffic we having included two (2) conditions: 1) "Normal Condition" due to daily/weekly traffic; 2) "Seasonal Condition" traffic due to biosolids land application activities that is in addition to the "Normal Condition" traffic. From the feedback received during the May 7th meeting it is our understanding that your office will determine impacts to the county roads based on these trip generation numbers.

Historical Traffic Volumes

The north adjacent road to the site is 270th Street with 620th Avenue/County Road S14/NE 72nd Street as the west adjacent road. The proposed site entrance is along 270th Street. We anticipate that the typical traffic route to/from the proposed WWTF site will use 270th Street west of the WWTF site entrance and 620th Avenue/County Road S14/NE 72nd Street north to US Highway 30.

The 2015 Iowa Department of Transportation (DOT) traffic map indicates the daily traffic volume at 140 vehicles per day (vpd) along 270th Street and 990 vpd along 620th Ave/S14/NE 72nd St.

Future "Normal Condition" Generated Traffic from WWTF Site

The 10th edition of the Institute of Transportation Engineers' (ITE) *Trip Generation Manual* was utilized to estimate the future average daily trips (ADT) for the WWTF site. The tables in the *ITE Trip Generation Manual* estimate the ingress and egress traffic for weekday traffic conditions for various types of land uses. For this purpose, the WWTF site was zoned as Light Industrial (most comparable land use type) with four (4) full-time employees. The total number of daily trips generated by the WWTF site was estimated to be approximately 24 total trips (12 entries, 12 exits). The AM peak hour can be expected to generate 5 total trips (4 entries, 1 exit), and the PM peak hour can be expected to generate 5 total trips (1 entry, 4 exits).

Given that the ITE *Trip Generation Manual* does not have a land use code for WWTFs, we also estimated future "Normal Condition" ADT for the proposed WWTF site based on feedback from the City of Nevada staff regarding typical traffic generated at the current WWTF. We anticipate similar trip generation when compared to the existing WWTF site with a slight increase due to additional staffing needs at the proposed WWTF site. This method resulted in an expected 13-14 total trips for a typical weekday.

Future "Seasonal Condition" Generated Traffic from WWTF Site

Based on historical activity at the existing WWTF site the seasonal biosolids land application activity would occur once per every 12 months. Current biosolids land application sites are located east of the proposed WWTF site. We anticipate biosolids hauling will use a combination of the following routes:

Route 1

- 270th Street west to 620th Avenue/County Road S14/NE 72nd Street; 620th Avenue/County Road S14/NE 72nd Street, south to 280th Street; 280th Street east to 630th Avenue; 630th Avenue south to 287th Street; 287th Street east to 640th Avenue; north on 640th Avenue.

Route 2

- 270th Street east 640th Avenue; south on 640th Avenue.

We are assuming traffic generated by biosolids hauling will be based on the use of two (2) semi-trucks with 6,000 gallon tanker trailers and up to two support vehicles (heavy-duty pickup trucks). We estimate that the "Seasonal Condition" duration will be 15 days total over a three (3) week period. It is unlikely the hauler will work 15 days straight for land application activities. Therefore, the anticipated total number of daily trips generated during the "Seasonal Condition" would be 84 trips.

Summary

Table 1 summarizes the daily and weekly trip generations for the proposed WWTF site.

Table 1. Proposed Nevada WWTF Site Projected Traffic Volumes

Condition	Total Trips	Daily Average (ADT)	Weekly Average
Normal – ITE Method	NA	24 *AM Peak = 5* *4 entries, 1 exit* *PM Peak = 5* *1 entry, 4 exits*	120 (M-F)
Normal – City feedback Method	65-70 (M-F) 8-12 (Sat-Sun)	13-14 (M-F) 4-6 (Sat – Sun)	78
Seasonal[1]	Up to 1,258[2]	84	420
[1] Once every 12 months; Based on 15 days total over 3 week period; 5 workdays per week			
[2] Based on 858 tanker trips and 400 support vehicle trips during the entire duration of land application process			

We request the opportunity to review and discuss your office's findings on the impacts from the projected traffic volumes to the county roads prior to submittal of the findings to Story County Planning & Zoning for the Conditional Use Permit.

Please feel free to contact me at (515) 657-5304 or mroth@hrgreen.com with any questions on this matter.

Sincerely,

HR GREEN, INC

Michael Roth, P.E.
Senior Project Manager

Cc: Jerry Moore, Story County
Mike Neal, City
Kerin Wright, City
Jordan Cook, City

\\hrgreen.com\HRG\Data\2016\160473\Design\Permits\Conditional Use Permit - Story County\Traffic\ltr-081420-CUP Traffic Letter-Story_Co_Engr.docx

D. Appendix D – Wetland Delineation Report

Wetland Delineation Report
Nevada Wastewater Treatment Facilities Improvement Project

Story County, Iowa

August 2020

HR Green Project No: 160473

Prepared For:

City of Nevada

Prepared by:

Ted McCaslin, PWS

HR Green, Inc.,

St. Paul, MN

HRGreen

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Appendices

Appendix A: Wetland Determination Data Forms
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1.0 Introduction

The City of Nevada is proposing construction a new wastewater treatment facility (WWTF) south of Nevada in Story County, Iowa. The approximately 77-acre site is currently mainly row crops with a grassed agricultural waterway and forested areas adjacent to West Indian Creek near a proposed outfall. The proposed WWTF site is in the southeast quarter of Section 31, Township 83 North, Range 22 West. It is approximately three miles south of the existing WWTF in Nevada. See Location Map in Figure 1.

The following sections describe the background data collected and reviewed, delineation methods, and results of the wetland delineation.

2.0 Background Data Collection and Review

The study area is in Land Resource Region (LRR) M – Central Feed Grains and Livestock Region, Illinois and Major Land Resource Region (MLRA) 103 – Central Iowa and Minnesota Till Prairies (NRCS, 2006).

2.1 USGS Quadrangle Map

The USGS The National Map topographic map was reviewed (ESRI Basemap, See Figure 1). Elevations in the study area are between 910 and 970feet. The site slopes towards an intermittent stream stretching from the northwest to the southeast within the study area and towards West Indian Creek. Areas along West Indian Creek along the southeast border appear forested. West Indian Creek is a tributary of Indian Creek and the South Skunk River. The South Skunk River and Skunk are tributaries of the Mississippi River.

2.2 National Wetlands Inventory (NWI)

The USFWS NWI GIS dataset for South Dakota was reviewed (See Figure 2). An R4SBC polygon (riverine, intermittent, streambed, seasonally flooded) is present near the intermittent stream shown in the USGS quadrangle. No other NWI polygons are present.

2.3 Story County NRCS Soil Data

A United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) web soil survey was reviewed for the project study area. Fifteen (15) soil map units are present. Two units – Nicollet loam, 1 to 3 percent slopes and Canisteo clay loam, Bemis moraine, 0 to 2 percent slopes – are listed as hydric. The two hydric units occupy approximately 12.0% of the study area and are located at higher elevations. No hydric soil units are associated with the intermittent stream area shown on the USGS Quadrangle or NWI mapping. Table 1 shows the NRCS web soil survey map units present in the study area (See Figure 2 and Appendix C).

TABLE 1: NRCS SOILS IN STUDY AREA

Map Unit Symbol	Map Unit Name	Hydric?	Drainage Class	% of Study Area
1314	Hanlon-Spillville complex, channeled, 0 to 2 percent slopes	No	Moderately well drained	0.3%
L138B	Clarion loam, Bemis moraine, 2 to 6 percent slopes	No	Well drained	24.9%
L55	Nicollet loam, 1 to 3 percent slopes	Yes	Poorly drained	11.8%
27B	Terril loam, 2 to 6 percent slopes	No	Well drained	8.6%
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	No	Well drained	6.2%
L638C2	Clarion-Storden complex, Bemis moraine, 6 to 10 percent slopes, moderately eroded	No	Moderately well drained	2.5%
L507	Canisteo clay loam, Bemis moraine, 0 to 2 percent slopes	Yes	Very poorly drained	0.2%
5010	Pits, gravel	Unranked	<Null>	2.4%
34C	Estherville sandy loam, 2 to 6 percent slopes	No	Well drained	3.4%
L62D2	Storden loam, Bemis moraine, 10 to 16 percent slopes, moderately eroded	No	Well drained	17.8%
L62E2	Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded	No	Well drained	9.8%
201B	Coland-Terril complex, 1 to 5 percent slopes	No	Moderately well drained	6.0%
356G	Hayden-Storden loams, 25 to 50 percent slopes	No	Well drained	0.1%
485	Spillville loam, 0 to 2 percent slopes, occasionally flooded	No	Somewhat poorly drained	3.9%
W	Water	Unranked	<Null>	0.6%
828B	Zenor sandy loam, 2 to 5 percent slopes	No	Somewhat excessively drained	1.5%

Source: USDA Web Soil Survey, NRCS SSURGO GIS Dataset for Story County, IA

2.4 FEMA National Flood Hazard Layer

The Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) online map was reviewed (See teal color in Figure 2). Flood Zone A (100-year floodplain) abuts West Indian Creek within the southeast part of the study area.

3.0 Methods

Wetland delineation activities were conducted by wetland scientist Ted McCaslin, PWS. An on-site wetland delineation was conducted on July 1, 2020. The delineation used methods described in the 1987 Corps of Engineers Wetlands Delineation Manual and the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region (Version 2.0) and 2010 Regional Supplement to the 1987 Corps of Engineers Delineation Manual.

Additionally, paired wetland points (one wetland/one upland) were sampled with a soil auger to a minimum depth of 20 inches for each sample point. Midwest Region data forms were completed for plant communities and for representative wetland and non-wetland sites within the study area. Wetland vegetation, soil indicators, hydrology indicators and other data were recorded on Midwest Region data forms at five (5) sample points within the study area. Additional plots were sampled throughout the study area to refine the wetland boundaries before the boundaries were recorded. Data forms are included in Appendix A.

Wetland boundaries were identified in the field, drawn on high-resolution photographs, and recorded with GPS equipment with sub-meter accuracy. Representative photographs taken during the field delineation are in Appendix B.

Potential streams were observed for stream indicators including ordinary high water marks (OHWM), running water, water flow direction, absence of vegetation within wetlands, active sediment sorting, bank erosion, and bank filling.

3.1 Vegetation

The hydrophytic vegetation criteria for wetland classification are met when greater than 50% of the dominant plant species are hydrophytes. The indicator status of plant species is expressed in terms of the estimated probabilities of that species occurring in wetland conditions within a given region. Hydrophytes include all plants with indicator status given as Facultative (FAC), Facultative Wet (FACW), or Obligate (OBL). Facultative Upland (FACU) and Upland (UPL) are not considered hydrophytes. The latest U.S. Army Corps of Engineers (USACE) National Wetland Plant List, Midwest indicators found in the 2018 Regional Wetland Plant List was used for species indicators.

3.2 Soils

A hydric soil is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation. Saturation or inundation, combined with soil microbial activity causes the depletion of oxygen. This promotes certain biogeochemical processes, such

as the accumulation of organic matter and the reduction, translocation, or accumulation of iron and other reducible elements. These processes result in distinctive characteristics, or field indicators, that persist in the soil during both wet and dry periods. Regionally specific hydric soil indicators are described in the USDA Field Indicators of Hydric Soils in the United States Version 8.2, 2018. Soils were evaluated for field indicators by directly by digging soil pits and using a soil probe in soils with heavy clay content. Soil colors are described using the Munsell color notation system in this report.

3.3 Hydrology

In order for an area to have wetland hydrology, it must exhibit one or more primary indicators and/or two or more secondary indicators for USACE jurisdictional and isolated wetlands. Primary indicators include either the direct presence of water as inundation or saturation within the upper 12 inches of the soil profile, or direct evidence of recent inundation including water marks, drift lines, sediment deposits, or drainage patterns. Secondary indicators are conditions reflecting anaerobic conditions produced because of saturation or inundation. Secondary indicators include such conditions as surface soil cracks, oxidized root channels in the upper 12 inches of the soil profile, crayfish burrows, and a positive “FAC-Neutral Test” (i.e., the dominant vegetation is, on average, hydrophytic).

4.0 Results

Most of the study area is in active crop rotation. A grassed waterway sloping from the northwest to the southeast crosses the study area. Additionally, several grassed upland terraces and a forested area along West Indian Creek are present. Three wetlands totaling 0.057 acres were identified in the study area. Wetlands are shown on Figure 3. See Table 2 for summary data on the wetlands.

Wetland 1 is located on a stream bench along West Indian Creek. The wetland appears to be part of the creek in aerial photos. The observed Cowardin Classification is PEMC. Hydrophytic vegetation spotted lady’s thumb (*Persicaria maculosa*) and reed canary grass (*Phalaris arundinacea*) were observed in the wetland. Hydric soil indicator Depleted Matrix (F3) and primary hydrology indicators Sediment Deposits (B2), Drift Deposits (B3), and Inundation Visible on Aerial Imagery (B7) were observed. See DP2-Wet in Appendix A and Photos 5 and 6 in Appendix B.

Wetland 2 is located within a long, grassed waterway in a vegetated cut depression. The wetland is incised and fed by a broken tile line at its upgradient limit. The wetland follows a drainage to West Indian Creek outside of the study area. The observed Cowardin Classification is PEMA. Hydrophytic vegetation reed canary grass (*Phalaris arundinacea*) and fox sedge (*Carex vulpinoidea*) were observed in the wetland. Hydric soil indicator Redox Dark Surface (F6) and secondary hydrology indicators Surface Soil Cracks (B6), Geomorphic Position (D2), and FAC-Neutral Test (D5) were observed. See DP1-Wet in Appendix A and Photo 7 in Appendix B.

Upland areas within the grassed waterway included area with dominant upland vegetation including smooth brome (*Bromus inermis*) and Canada thistle (*Cirsium arvense*), but also some areas of reed canary grass. Primary wetland hydrology indicators were absent from the waterway the day of the site visit. See DP1-Up and Photos 2, 3, and 4 in Appendix B.

Wetland 3 is an isolated six-foot-deep depression caused by a cave-in above a broken tile line. The observed Cowardin classification is PEMB. The isolated wetland showed hydrophytic vegetation and surface inundation approximately six feet below the surrounding upland within the grassed waterway. The wetland was inaccessible but mapped in Figure 3. See Photo 10 in Appendix B.

TABLE 2: WETLANDS IN STUDY AREA

Feature	Area (acres)	Latitude (Dec Degr)	Longitude (Dec Degr)	Cowardin Class	Associated Wetland Data Point
Wetland 1	0.010	41.958007	-93.448963	PEMC	DP2-Wet DP2-Up
Wetland 2	0.042	41.960033	-93.447867	PEMA	DP1-Wet DP1-Up
Wetland 3	0.005	41.962852	-93.453547	PEMB	DP1-Wet DP1-Up
Total	**0.057**				

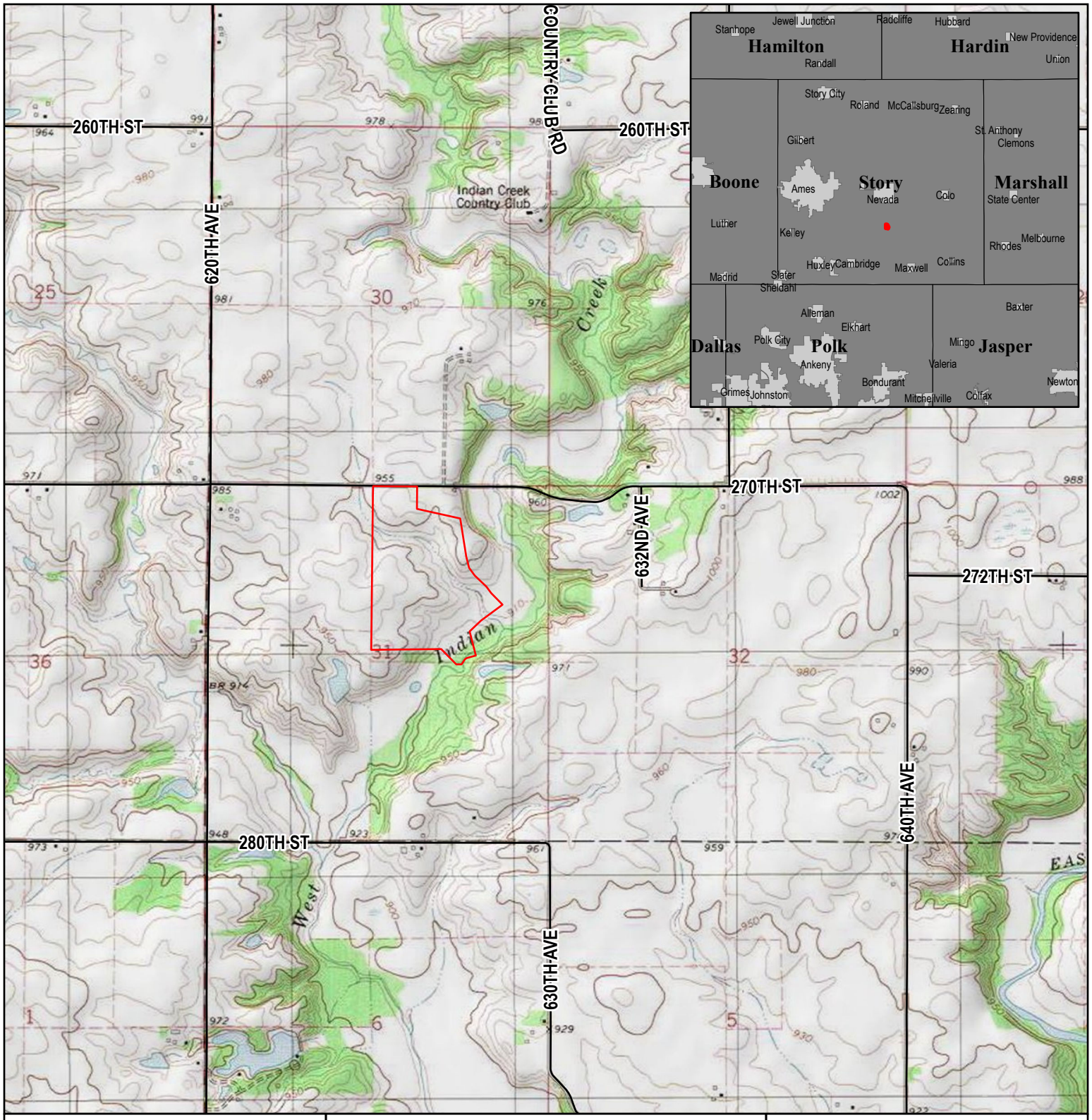
4.2 Other Waters of the United States

The study area abuts West Indian Creek, a perennial stream approximately 35-40 feet wide within the study area. The creek has a steep upland vegetated bank outside of Wetland 1. The stream flows generally southward. See Photo XX in Appendix B.

5.0 Summary

A wetland delineation identified three wetlands totaling 0.057 acres within the study area. Additionally, the study area abuts West Indian Creek. An intermittent stream shown on USGS Quadrangle and NWI maps showed two small wetlands where an observed tile line had failed, but the majority of the grassed waterway is upland.

FIGURES



Wetland Study Area

FIGURE 1 - USGS/LOCATION MAP

NEVADA WWTF

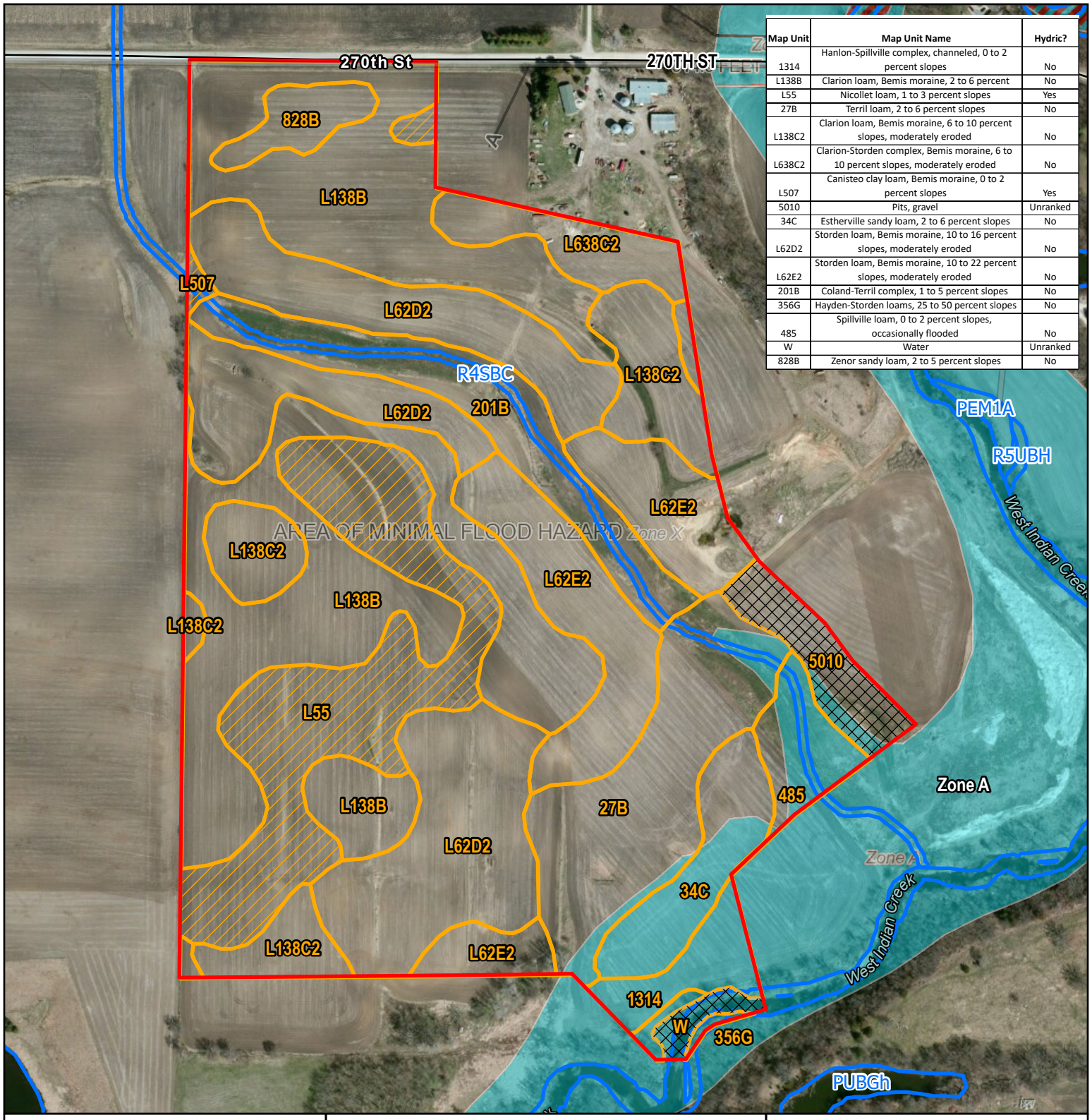
WETLAND DELINEATION

Story County, Iowa

N
W E
S

0 1,000 2,000
Feet

HRGreen



Map Unit	Map Unit Name	Hydric?
1314	Hanlon-Spillville complex, channeled, 0 to 2 percent slopes	No
L138B	Clarion loam, Bemis moraine, 2 to 6 percent	No
L55	Nicollet loam, 1 to 3 percent slopes	Yes
27B	Terril loam, 2 to 6 percent slopes	No
L138C2	Clarion loam, Bemis moraine, 6 to 10 percent slopes, moderately eroded	No
L638C2	Clarion-Storden complex, Bemis moraine, 6 to 10 percent slopes, moderately eroded	No
L507	Canisteo clay loam, Bemis moraine, 0 to 2 percent slopes	Yes
5010	Pits, gravel	Unranked
34C	Estherville sandy loam, 2 to 6 percent slopes	No
L62D2	Storden loam, Bemis moraine, 10 to 16 percent slopes, moderately eroded	No
L62E2	Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded	No
201B	Coland-Terril complex, 1 to 5 percent slopes	No
356G	Hayden-Storden loams, 25 to 50 percent slopes	No
485	Spillville loam, 0 to 2 percent slopes, occasionally flooded	No
W	Water	Unranked
828B	Zenor sandy loam, 2 to 5 percent slopes	No

Wetland Study Area
National Wetlands Inventory
Hydric Soil Unit?
Yes
No
Unranked
NFHL
Cross-Sections
Flood Hazard Boundaries
Other Boundaries
Limit Lines
Other Boundaries
Limit Lines

FIGURE 2 - SOILS/NWI/FEMA

NEVADA WWTF

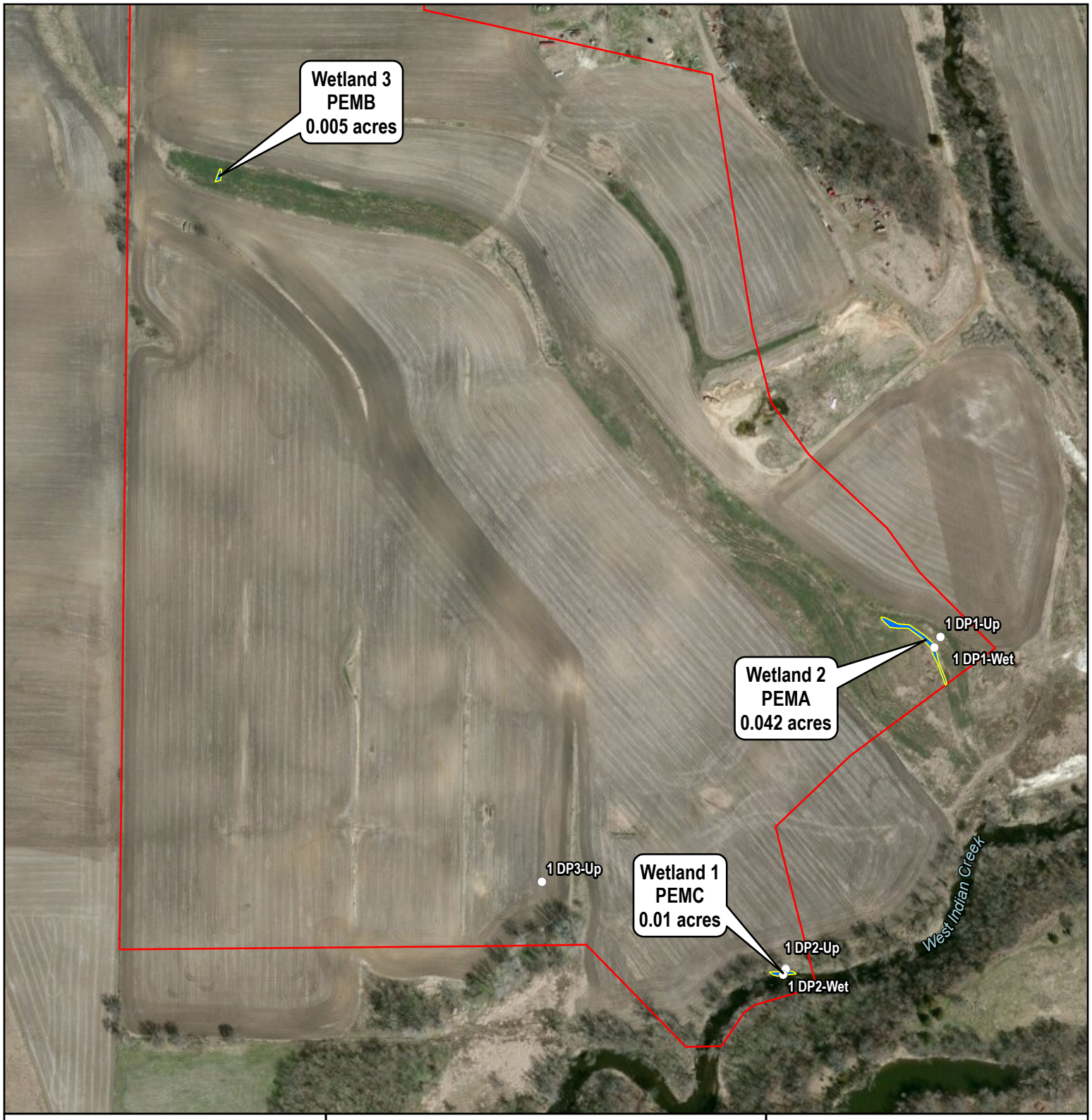
WETLAND DELINEATION

Story County, Iowa

N
W E
S

0 200 400
Feet

HRGreen



Wetland Study Area
SamplingPoints
Delineated Wetlands

FIGURE 3
DELINEATED WETLANDS

NEVADA WWTF

WETLAND DELINEATION

Story County, Iowa

N
W E
S

0 150 300
Feet

HRGreen

APPENDIX A: WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Nevada WWTP City/County: Nevada/Story Sampling Date: 2020-07-01

Applicant/Owner: City of Nevada State: Iowa Sampling Point: DP-1 Up

Investigator(s): Ted McCaslin, PWS Section, Township, Range: 31, T83N, 22W

Landform (hillslope, terrace, etc.): Upland, Hillslope Local relief (concave, convex, none): None

Slope (%): 2 Lat: 41.960050 Long: -93.447675 Datum: WGS 84

Soil Map Unit Name: 5010 Pits, sand and gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil ✔, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✔

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:
Possible disturbed soils apparent on aerial photography. Drain tile adjacent.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft r)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5 ft r)			
1. Bromus inermis	55	✔	FACU
2. Phalaris arundinacea	50	✔	FACW
3. Urtica dioica	10		FACW
4. Cirsium arvense	5		FACU
5.			
6.			
7.			
8.			
9.			
10.			
	120% = Total Cover		
Woody Vine Stratum (Plot size: 30 ft r)			
1.			
2.			
	_____ = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	60	x 2 = 120
FAC species	0	x 3 = 0
FACU species	60	x 4 = 240
UPL species	0	x 5 = 0
Column Totals:	120 (A)	360 (B)

Prevalence Index = B/A = 3.0

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ✔ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-1 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0 - 2	10YR 3/2	100					Silty clay loam	
2 - 12	10YR 3/2	94	10YR 4/4	6	C	M	Silty clay loam	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Dark Surface (S7)
- ___ Iron-Manganese Masses (F12)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Rocks

Depth (inches): 12

Hydric Soil Present? Yes _____ No ✔

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Drain tile approximately for feet deep apparent adjacent to the south.

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Nevada WWTP City/County: Nevada/Story Sampling Date: 2020-07-01

Applicant/Owner: City of Nevada State: Iowa Sampling Point: DP1- Wet

Investigator(s): Ted McCaslin, PWS Section, Township, Range: 31, T83N, R22W

Landform (hillslope, terrace, etc.): Outwash, Depression Local relief (concave, convex, none): Concave

Slope (%): 1 Lat: 41.959985 Long: -93.447723 Datum: WGS 84

Soil Map Unit Name: 5010 Pits, sand and gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil ✔, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✔

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes ✔ No _____
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks:
Vegetated drainageway in possible cut channel. Tile observed upgradient from point

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft r)			
1. Populus deltoides	1		FAC
2.			
3.			
4.			
5.			
	1% = Total Cover		
Herb Stratum (Plot size: 5 ft r)			
1. Carex vulpinoidea	30	✔	FACW
2. Phalaris arundinacea	10	✔	FACW
3. Ambrosia trifida	7		FAC
4. Bidens tripartita	5		OBL
5. Persicaria pensylvanica	5		FACW
6. Setaria pumila	5		FAC
7. Ambrosia artemisiifolia	3		FACU
8.			
9.			
10.			
	65% = Total Cover		
Woody Vine Stratum (Plot size: 30 ft r)			
1.			
2.			
	_____ = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	5	x 1 = 5
FACW species	45	x 2 = 90
FAC species	13	x 3 = 39
FACU species	3	x 4 = 12
UPL species	0	x 5 = 0
Column Totals:	66 (A)	146 (B)

Prevalence Index = B/A = 2.2

Hydrophytic Vegetation Indicators:

✔ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

✔ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP1- Wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 5	10YR 2/1	80	10YR 8/1	20	D	M	Sandy loam	
5 - 20	10YR 6/3	60	10YR 4/1	40	D	M	Silty clay loam	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✔ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Dark Surface (S7)
- ___ Iron-Manganese Masses (F12)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ✔ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ✔ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): _____

Water Table Present? Yes ___ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Nevada WWTP City/County: Nevada/Story Sampling Date: 2020-07-01

Applicant/Owner: City of Nevada State: Iowa Sampling Point: DP2-Up

Investigator(s): Ted McCaslin, PWS Section, Township, Range: 31, T83N, R22W

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): _____

Slope (%): 3 Lat: 41.958033 Long: -93.448957 Datum: WGS 84

Soil Map Unit Name: 485-Spillville loam, 0 to 2 percent slopes, occasionally flooded NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:
Field edge above creek

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1. Juglans nigra	65	✔	FACU
2. Acer negundo	15		FAC
3.			
4.			
5.			
	80%	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft r)			
1. Acer negundo	10	✔	FAC
2. Lonicera tatarica	10	✔	FACU
3.			
4.			
5.			
	20%	= Total Cover	
Herb Stratum (Plot size: 5 ft r)			
1. Phalaris arundinacea	60	✔	FACW
2. Urtica dioica	25	✔	FACW
3. Alliaria petiolata	15		FAC
4. Amphicarpaea bracteata	15		FAC
5.			
6.			
7.			
8.			
9.			
10.			
	115%	= Total Cover	
Woody Vine Stratum (Plot size: 30 ft r)			
1. Smilax hispida	7	✔	FAC
2.			
	7%	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	85	x 2 = 170
FAC species	62	x 3 = 186
FACU species	75	x 4 = 300
UPL species	0	x 5 = 0
Column Totals:	222 (A)	656 (B)

Prevalence Index = B/A = 3.0

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✔ 2 - Dominance Test is >50%
- ✔ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP2-Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 24	10YR 3/2	100					Silt Loam	
-								
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Dark Surface (S7)
- ___ Iron-Manganese Masses (F12)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Nevada WWTP City/County: Nevada/Story Sampling Date: 2020-07-01

Applicant/Owner: City of Nevada State: Iowa Sampling Point: DP2-Wet

Investigator(s): Ted McCaslin, PWS Section, Township, Range: 31, T83N, R22W

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Convex

Slope (%): 0 Lat: 41.957998 Long: -93.450921 Datum: WGS 84

Soil Map Unit Name: Water NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes ✔ No _____
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks:
Stream bench

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft r)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5 ft r)			
1. Persicaria maculosa	25	✔	FACW
2. Phalaris arundinacea	12	✔	FACW
3. Urtica dioica	10		FACW
4. Pilea pumila	8		FACW
5. Calystegia sepium	5		FAC
6. Humulus japonicus	5		FACU
7. Ambrosia trifida	3		FAC
8.			
9.			
10.			
	68% = Total Cover		
Woody Vine Stratum (Plot size: 30 ft r)			
1.			
2.			
	_____ = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	55	x 2 = 110
FAC species	8	x 3 = 24
FACU species	5	x 4 = 20
UPL species	0	x 5 = 0
Column Totals:	68 (A)	154 (B)

Prevalence Index = B/A = 2.3

Hydrophytic Vegetation Indicators:

✔ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

✔ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP2-Wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 3	10YR 2/1	60	10YR 4/1	30	D	M	Sandy clay loam	
0 - 3			10YR 5/8	10	C	M		
3 - 20	10YR 4/2	82	10YR 8/1	15	D	M	Sand	
3 - 20			10YR 5/8	3	C	M		
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✔ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Dark Surface (S7)
- ___ Iron-Manganese Masses (F12)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ✔ Sediment Deposits (B2)
- ✔ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- X Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✔ Geomorphic Position (D2)
- ✔ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): _____

Water Table Present? Yes ___ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Nevada WWTP City/County: Nevada/Story Sampling Date: 2020-07-01

Applicant/Owner: City of Nevada State: Iowa Sampling Point: DP3 -Up

Investigator(s): Ted McCaslin, PWS Section, Township, Range: 31, T83N, R22W

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave

Slope (%): 0 Lat: 41.958563 Long: -93.450921 Datum: WGS 84

Soil Map Unit Name: L62E2-Storden loam, Bemis moraine, 10 to 22 percent slopes, moderately eroded NWI classification: PEMA

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation ✔, Soil _____, or Hydrology ✔ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No ✔

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:
NWI polygon in crop field. Large cave-in downgradient draining the depression.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft r)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft r)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5 ft r)			
1. Phalaris arundinacea	30	✔	FACW
2. Glycine max	3		NI
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	33% = Total Cover		
Woody Vine Stratum (Plot size: 30 ft r)			
1.			
2.			
	_____ = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x 1 = 0
FACW species	30	x 2 = 60
FAC species	0	x 3 = 0
FACU species	0	x 4 = 0
UPL species	0	x 5 = 0
Column Totals:	30 (A)	60 (B)

Prevalence Index = B/A = 2.0

Hydrophytic Vegetation Indicators:

✔ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

✔ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks: (Include photo numbers here or on a separate sheet.)
Sprayed

SOIL

Sampling Point: DP3 -Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0 - 12	10YR 3/2	97	10YR 6/2	3	D	M	Silty clay loam	
12 - 16	10YR 2/1	90	10YR 6/2	10	D	M	Silty clay loam	
-								
-								
-								
-								
-								

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Coast Prairie Redox (A16)
- ___ Dark Surface (S7)
- ___ Iron-Manganese Masses (F12)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ✔ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

APPENDIX B: SITE PHOTOGRAPHS

Photo 1. Facing north, top of grassed waterway at right of photo.

Photo 2. Facing southeast at top of grassed waterway.

Photo 3. Typical vegetation within grassed waterway with dominant smooth brome (FACU) at left and reed canary grass at right (FACW).

Photo 4. Looking southeast at upland vegetation in grassed waterway near east edge of study area.

Photo 5. Facing north, Wetland 1 at left of photo and West Indian Creek at right of photo.

Photo 6. Facing south from Wetland 1 at steep bank on west side of West Indian Creek.

Photo 7. Looking south at pole within Wetland 2 in incised area of grassed waterway.

Photo 8. Cave-in at field edge near DP3-Up.

Photo 9. Facing north at west edge of study area in southwest part of study area.

Photo 10. Facing south, Wetland 3 at tile cave-in within grassed waterway.

E. Appendix E – WLA

City of Nevada

Proposed New Mechanical Facility

(Please do not microfiche this document.)

This Package Contains

WASTELOAD ALLOCATION CALCULATIONS & NOTES

Please Do Not Separate

ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY BASED PERMIT LIMITS

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: Nevada, City of STP — Sewage File Number: 6-85-62-0-01

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)
Outfall No. 001	**ADW = 1.64 mgd & AWW = 3.02 mgd**			
CBOD5	Secondary Treatment Levels Will Not Violate WQS			
Total D.O.	Minimum Concentration (mg/l)			
January - December	5.0			
Ammonia – Nitrogen*				
January	3.5	15.2	87.6	382.8
February	4.1	14.2	101.6	357.8
March	3.5	14.7	87.5	370.1
April	1.6	15.7	39.2	395.7
May	1.8	15.2	44.7	382.7
June	1.4	**12.7**	33.7	**292.2**
July	1.0	**8.8**	25.8	**199.0**
August	1.0	**8.2**	24.5	**186.4**
September	1.1	**11.3**	27.2	**256.9**
October	1.6	15.7	40.0	395.7
November	2.4	14.7	59.7	370.1
December	2.6	16.0	63.6	402.2
Bacteria	Geometric Mean (#org./100 ml)		March 15th – November 15th	
E. coli	211			
Chloride	392	629	9,837	15,847
Sulfate	1,515	1,515	38,145	38,145
TRC**	0.008	0.019	0.199	0.479
pH	6.5 - 9.0 Standard Units			
Major Facility Acute WET Testing Ratio: Use 99.9% of effluent and 0.1% of dilution water for the testing				

Stream Network/Classification of Receiving Stream:
West Branch Indian Creek (A2, B(WW-2)) to Indian Creek (A1, B(WW-2)) to the South Skunk River (A1, B(WW-1) HH)

Annual critical low flows in West Branch Indian Creek at the outfall:
1Q10 flow 0.1 cfs, 7Q10 flow 0.1 cfs, 30Q10 flow 0.1 cfs

Annual critical low flows in the South Skunk River at (or just upstream of) the mouth of Indian Creek:
1Q10 flow 9.20 cfs, 7Q10 flow 12.3 cfs, 30Q10 flow 16.7 cfs, 30Q5 flow 26.3 cfs, harmonic mean flow 88.5 cfs

Excel spreadsheet calculations [X] Qual II E model [ ] Qual II E modeling date [ ]

Performed by: Ian Willard

* **Bold** values are governed by CBOD5/DO modeling; the others are based on ammonia nitrogen toxicity protection for aquatic life.
** Only required if chlorine is used for disinfection.

Antidegradation Review Requirement

A tier II antidegradation review is required. See Section 2 for details.

Please note that the antidegradation review conducted in this wasteload allocation is based on the current information available. Antidegradation could also be triggered during the NPDES permitting process based on new information.

ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY BASED PERMIT LIMITS

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: Nevada, City of STP — Sewage File Number: 6-85-62-0-01

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)
Outfall No. 001	**ADW = 1.64 mgd & AWW = 3.02 mgd**			
Toxics				
1,1,1-Trichloroethane	2.643E+01	2.643E+01	6.653E+02	6.653E+02
1,1-Dichloroethylene	5.405E+01	5.405E+01	1.026E+03	1.361E+03
1,2-Dichloroethane	3.597E+00	5.906E+01	5.345E+01	1.487E+03
1,2-Dichloropropane	1.458E+00	1.458E+00	2.167E+01	2.167E+01
2,3,7,8-TCDD (Dioxin)	4.958E-10	4.958E-10	7.368E-09	7.368E-09
3,3-Dichlorobenzidine	2.722E-03	2.722E-03	4.045E-02	4.045E-02
4,4' DDT	1.010E-06	1.101E-03	2.532E-05	2.772E-02
Aldrin	4.860E-06	3.003E-03	7.223E-05	7.560E-02
Aluminum	8.786E-02	7.507E-01	2.203E+00	1.890E+01
Antimony	2.299E+00	1.101E+01	3.881E+01	2.772E+02
Arsenic (III)	1.515E-01	3.403E-01	3.798E+00	8.568E+00
Barium	2.052E+02	2.052E+02	5.166E+03	5.166E+03
Benzene	4.958E+00	1.652E+01	7.368E+01	4.158E+02
Benzo(a)Pyrene	1.750E-03	1.750E-03	2.600E-02	2.600E-02
Beryllium	5.005E-01	5.005E-01	1.260E+01	1.260E+01
Bis(2-ethylhexyl)phthalate	2.139E-01	2.139E-01	3.178E+00	3.178E+00
Bromoform	1.361E+01	1.361E+01	2.023E+02	2.023E+02
Cadmium	4.567E-04	4.320E-03	1.145E-02	1.088E-01
Carbon Tetrachloride	1.555E-01	2.157E+01	2.311E+00	5.431E+02
Chlordane	4.342E-06	2.402E-03	1.089E-04	6.048E-02
Chloride	3.92E+02	6.29E+02	9.837E+03	1.5847E+04
Chlorobenzene	5.746E+00	1.612E+01	9.701E+01	4.057E+02
Chlorodibromomethane	1.264E+00	1.264E+00	1.878E+01	1.878E+01
Chloroform	4.569E+01	4.569E+01	6.790E+02	6.790E+02
Chloropyrifos	4.140E-05	8.308E-05	1.038E-03	2.092E-03
Chromium (VI)	1.111E-02	1.602E-02	2.785E-01	4.032E-01
Copper	1.703E-02	2.693E-02	4.271E-01	6.779E-01
Cyanide	5.251E-03	2.202E-02	1.317E-01	5.544E-01
Dichlorobromomethane	1.653E+00	1.653E+00	2.456E+01	2.456E+01
Dieldrin	5.249E-06	2.402E-04	7.801E-05	6.048E-03
Endosulfan	5.655E-05	2.202E-04	1.418E-03	5.544E-03
Endrin	3.635E-05	8.608E-05	9.116E-04	2.167E-03
Ethylbenzene	7.542E+00	2.267E+01	1.273E+02	5.708E+02
Fluoride	8.085E+00	8.085E+00	2.035E+02	2.035E+02
gamma-Hexachlorocyclohexane (Lindane)	9.509E-04	9.509E-04	2.394E-02	2.394E-02
Heptachlor	3.837E-06	5.205E-04	9.622E-05	1.310E-02

ENVIRONMENTAL SERVICES DIVISION
WATER QUALITY BASED PERMIT LIMITS

SECTION VI: WATER QUALITY-BASED PERMIT LIMITS

Facility Name: Nevada, City of STP — Sewage File Number: 6-85-62-0-01

Parameters	Ave. Conc. (mg/l)	Max. Conc. (mg/l)	Ave. Mass (lbs/d)	Max. Mass (lbs/d)
Outfall No. 001	**ADW = 1.64 mgd & AWW = 3.02 mgd**			
Toxics				
Heptachlor epoxide	3.791E-06	5.205E-04	5.634E-05	1.310E-02
Hexachlorobenzene	2.819E-05	2.819E-05	4.189E-04	4.189E-04
Hexachlorocyclopentadiene	3.951E+00	3.951E+00	6.670E+01	6.670E+01
Iron	1.001E+00	1.001E+00	2.520E+01	2.520E+01
Lead	7.769E-03	1.976E-01	1.948E-01	4.975E+00
Mercury (II)	5.387E-04	1.642E-03	9.095E-03	4.133E-02
Nickel	9.469E-02	8.442E-01	2.374E+00	2.125E+01
Nitrate as N	3.203E+02	3.203E+02	8.064E+03	8.064E+03
Nitrate+Nitrite as N	3.203E+02	3.203E+02	8.064E+03	8.064E+03
para-Dichlorobenzene	6.824E-01	2.002E+00	1.152E+01	5.040E+01
Parathion	1.313E-05	6.506E-05	3.292E-04	1.638E-03
Pentachlorophenol (PCP)	2.257E-02	2.917E-02	5.660E-01	7.343E-01
Phenols	5.049E-02	2.502E+00	1.266E+00	6.300E+01
Polychlorinated Biphenyls (PCBs)	6.221E-06	2.002E-03	9.246E-05	5.040E-02
Polynuclear Aromatic Hydrocarbons (PAHs)	6.636E-05	3.003E-02	1.253E-03	7.560E-01
Selenium	5.049E-03	1.932E-02	1.266E-01	4.864E-01
Silver	3.804E-03	3.804E-03	9.576E-02	9.576E-02
Sulfate	1.515E+03	1.515E+03	3.8145E+04	3.8145E+04
Tetrachloroethlyene	3.208E-01	3.208E-01	4.767E+00	4.767E+00
Thallium	1.688E-03	5.986E-01	2.850E-02	1.507E+01
Toluene	1.106E-01	2.727E+00	2.088E+00	6.607E+01
Total Residual Chlorine (TRC)**	8E-03	1.9E-02	1.99E-01	4.79E-01
Toxaphene	2.020E-06	7.307E-04	5.064E-05	1.840E-02
trans-1,2-Dichloroethylene	5.028E-01	5.028E-01	8.489E+00	8.489E+00
Trichloroethylene (TCE)	8.079E-02	4.004E+00	2.026E+00	1.008E+02
Vinyl Chloride	2.333E-01	2.333E-01	3.467E+00	3.467E+00
Zinc	2.158E-01	2.158E-01	5.432E+00	5.432E+00

WLAs/Permit Limits for the City of Nevada's Proposed New Mechanical Facility

These wasteload allocations and water quality based permit limitations are for the City of Nevada's wastewater discharge from a proposed new mechanical facility. The wasteload allocations/permit limits are based on the Water Quality Standards (IAC 567.61) and 'Iowa Wasteload Allocation (WLA) Procedure', February 21, 2018. The chloride allocation/permit limits are based on the criteria that became effective on November 11, 2009.

The water quality based limits in this WLA are calculated to meet the surface water quality criteria to protect downstream uses. There could be technology based limits applicable to this facility that are more stringent than the water quality based limits shown in this WLA. The technology based limits could be derived from either federal guidelines based on different industrial categories or permit writer's judgment.

1. BACKGROUND:
The City of Nevada currently discharges treated domestic wastewater from a mechanical (trickling filter) wastewater treatment facility into Unnamed Creek.

The City of Nevada is proposing to build a new mechanical (activated sludge) wastewater treatment facility at a new location. The design flows and design mass loadings used throughout this WLA are proposed values for the proposed new mechanical facility. The proposed new mechanical facility would discharge into West Branch Indian Creek (at 41° 57' 31.667" N, 93° 26' 50.871" W).

Route of flow and use designations:
At the outfall, West Branch Indian Creek is an A2, B(WW-2) designated use waterbody. Approximately 23,980 ft downstream of the outfall, West Branch Indian Creek flows into Indian Creek. Directly downstream of the mouth of West Branch Indian Creek, Indian Creek is an A1, B(WW-2) designated use waterbody. Approximately 128,710 ft downstream of the mouth of West Branch Indian Creek, Indian Creek flows into the South Skunk River. Directly downstream of the mouth of Indian Creek, the South Skunk River is an A1, B(WW-1) HH designated use waterbody.

The designations have been adopted in Iowa's state rule described in the rule referenced document of Surface Water Classification effective on June 17, 2015. Based on the pollutants of concern, the use designations of waterbodies further downstream will not impact the resulting limits for this facility.

Critical low flow determination:
The annual critical low flows in West Branch Indian Creek at the outfall are estimated based on the Regional Regression Equations (RRE) from 'Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa', 2012 (revised 2013).

The annual critical low flows in the South Skunk River at (or just upstream of) the mouth of Indian Creek are estimated based on the Weighted Drainage Area Ratio (WDAR) method from 'Methods for estimating selected low-flow frequency statistics and harmonic mean flows for streams in Iowa', 2012 (revised 2013) and flow statistics obtained at USGS gage station 05471050, located on the South Skunk River at Colfax, Iowa.

Table 1a: Annual Critical Low Flows in West Branch Indian Creek

Location	D.A. (mi^2)	1Q10 (cfs)	7Q10 (cfs)	30Q10 (cfs)
West Branch Indian Creek at the outfall	44	0.1	0.1	0.1

Table 1b: Annual Critical Low Flows in the South Skunk River

Location	D.A. (mi^2)	1Q10 (cfs)	7Q10 (cfs)	30Q10 (cfs)	30Q5 (cfs)	Harmonic Mean (cfs)
The South Skunk River at (or just upstream of) the mouth of Indian Creek	814	9.20	12.3	16.7	26.3	88.5

2. ANTIDEGRADATION REVIEW:

According to the Iowa Antidegradation Implementation Procedure, effective February 17, 2010 (IAC 567-61.2(2).e), all new or expanded regulated activities (with limited exceptions, such as unsewered communities) are subject to antidegradation review requirements.

Table 2: Antidegradation Review Analysis

Item #	Factor or Scenario	Antidegradation Determination	Analysis/Comments
1	Design Capacity Increase	Yes ☒, No ☐, or Not Applicable ☐	1: Proposed design capacity shown on the request form.
2	Significant Industrial Users (SIU) Contributing New Pollutant of Concern (POC)	Yes ☐, No ☒, or Not Applicable ☐	
3	New Process Contributing New Pollutant of Concern (POC)	Yes ☒, No ☐, or Not Applicable ☐	1: Note that if chlorine is utilized for disinfection in the future an antidegradation review will be required.
4	Less Stringent Water Quality Based Limits?	Yes ☒, No ☐, or Not Applicable ☐	1: Less stringent copper and ammonia nitrogen limits will trigger an antidegradation review.
5	Outfall Location Change	Yes ☒, No ☐, or Not Applicable ☐	
Conclusion and discussion: Due to Items 1, 3, 4, and 5, a tier II antidegradation review is required. Please note that the antidegradation review conducted in this WLA is based on the current information available. Antidegradation could also be triggered during the NPDES permitting process based on new information.			

3. TOTAL MAXIMUM DAILY LOAD (TMDL) LIMITATIONS:

The following waterbodies in the discharge route are on the 2016 impaired waters list:

- Indian Creek for bacteria (indicator bacteria, *E. coli*) and biological (low aquatic macroinvertebrate IBI)
- The South Skunk River for bacteria (indicator bacteria, *E. coli*)
- The Skunk River for bacteria (indicator bacteria, *E. coli*)
- The Mississippi River for metals (aluminum)

The City of Nevada STP has not been assigned allocations in any TMDLs at this time.

Please note that the results presented in this report are wasteload allocations based on meeting the State's current water quality standards in the receiving waterbody. Additional and/or more stringent effluent limits may be applicable to this discharge based on approved TMDLs for impaired waterbodies, which may provide watershed based wasteload allocations. Information on impaired streams in Iowa and approved TMDLs can be found at the following website: http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Improvement/Impaired-Waters.

4. CALCULATIONS:
The WLAs/permit limits for this outfall are calculated based on the facility's proposed Average Dry Weather (ADW) design flow of 1.64 mgd and its proposed Average Wet Weather (AWW) design flow of 3.02 mgd.

Please note that only wasteload allocations/permit limits (water quality based effluent limits) calculated using DNR approved design flows can be applied in NPDES permits. Water quality based effluent limits calculated using proposed flows that have not been approved by the DNR for permitting and compliance may be used for informational purposes only.

The water quality based permit concentration limits are derived using the allowed stream flow and the proposed ADW design flow, while the loading limits are derived using the allowed stream flow and the proposed AWW design flow.

Toxics:
The toxics wasteload allocations will consider the procedures included in the 2000 revised WQS and the 2007 chemical criteria.

To protect the aquatic life use:
Important to toxics is the use of the 1Q10 stream flow in association with the acute wasteload allocation calculation. The chronic WLA will continue to use the 7Q10 stream flow in its calculations. In this case, 25% of the 7Q10 flow and 2.5% of the 1Q10 flow in West Branch Indian Creek at the outfall are used as the Mixing Zone (MZ) and the Zone of Initial Dilution (ZID), respectively.

To protect the human health (HH) use:
For pollutants that are non-carcinogenic and have criteria for human health protection, the criteria apply at the end of the MZ, which in this case is 25% of the 30Q5 flow in the South Skunk River at (or just upstream of) the mouth of Indian Creek.

For pollutants that are carcinogenic and have criteria for human health protection, the criteria apply at the end of the MZ, which in this case is 25% of the harmonic mean flow in the South Skunk River at (or just upstream of) the mouth of Indian Creek.

Final limits:
The maximum limits are those calculated for the protection of the aquatic life use and the average limits are the more stringent between those for the protection of the aquatic life use and those for the protection of the HH use.

Please note that the TRC limits are based on a sampling frequency of 5/week, based on a proposed design population equivalent (PE) of 36,365; the limits for other toxics are based on a sampling frequency of 1/week.

Ammonia Nitrogen:
Standard stream background pH, temperatures, and concentrations of NH3-N are mixed with the discharge from the facility's effluent pH and temperature values to calculate the applicable instream criteria for the protection of West Branch Indian Creek.

Based on the ratio of the stream flow to the discharge flow, 5% of the 1Q10 flow and 100% of the 30Q10 flow in West Branch Indian Creek at the outfall are used as the ZID and the MZ, respectively. At the outfall, West Branch Indian Creek is a B(WW-2) stream; therefore, early life protection will begin in April and run through September.

The monthly background pH, temperatures, and NH3-N concentrations shown in Table 3 are used for the wasteload allocation/permit limits calculations based on the Year 2000 ammonia nitrogen criteria. Table 4 shows the statewide monthly effluent pH and temperature values for mechanical facilities. Table 5a shows the calculated toxicity based ammonia nitrogen wasteload allocations for this facility. Additionally, Table 5b shows the final ammonia nitrogen wasteload allocations for this facility with reductions from the CBOD5/DO modeling (discussed below).

Table 3: Background pH, Temperatures, and NH3-N Concentrations
For Use with Year 2000 Ammonia Nitrogen Criteria

Months	pH	Temperature (°C)	NH_3-N (mg/l)
January	8.1	0.3	0.02
February	8.0	0.1	0.08
March	8.1	1.5	0.12
April	8.3	9.3	0.03
May	8.2	15.0	0.03
June	8.2	19.4	0.02
July	8.2	23.5	0.02
August	8.2	24.3	0.02
September	8.3	20.2	0.02
October	8.3	14.2	0.02
November	8.3	8.0	0.02
December	8.3	0.8	0.03

Table 4: Standard Effluent pH & Temperature Values for Mechanical Facilities

Months	pH	Temperature (°C)
January	7.67	12.4
February	7.71	11.3
March	7.69	13.1
April	7.65	16.2
May	7.67	19.3
June	7.70	22.1
July	7.58	24.1
August	7.63	24.4
September	7.62	22.8
October	7.65	20.2
November	7.69	17.1
December	7.64	14.1

Table 5a: Toxicity Based Wasteload Allocations for Ammonia Nitrogen
For the Protection of Aquatic Life

Months	ADW-Based*		AWW-Based**	
	Acute (mg/l)	Chronic (mg/l)	Acute (mg/l)	Chronic (mg/l)
January	15.2	3.5	15.2	3.5
February	14.2	4.1	14.2	4.0
March	14.7	3.5	14.7	3.5
April	15.7	1.6	15.7	1.6
May	15.2	1.8	15.2	1.8
June	14.5	1.4	14.4	1.3
July	17.6	1.0	17.6	1.0
August	16.2	1.0	16.2	1.0
September	16.5	1.1	16.5	1.1
October	15.7	1.6	15.7	1.6
November	14.7	2.4	14.7	2.4
December	16.0	2.6	16.0	2.5

*: bases for concentration limits; **: bases for mass loading limits

Table 5b: Final Wasteload Allocations for Ammonia Nitrogen
For the Protection of Aquatic Life after CBOD5/DO Modeling*

Months	ADW-Based**		AWW-Based***	
	Acute (mg/l)	Chronic (mg/l)	Acute (mg/l)	Chronic (mg/l)
January	15.2	3.5	15.2	3.5
February	14.2	4.1	14.2	4.0
March	14.7	3.5	14.7	3.5
April	15.7	1.6	15.7	1.6
May	15.2	1.8	15.2	1.8
June	**12.7**	1.4	**11.6**	1.3
July	**8.8**	1.0	**7.9**	1.0
August	**8.2**	1.0	**7.4**	1.0
September	**11.3**	1.1	**10.2**	1.1
October	15.7	1.6	15.7	1.6
November	14.7	2.4	14.7	2.4
December	16.0	2.6	16.0	2.5

*: **Bold** values are governed by CBOD5/DO modeling, while the other values are based on ammonia nitrogen toxicity protection for aquatic life
**: bases for concentration limits
***: bases for mass loading limits

CBOD5/Total Dissolved Oxygen:
Streeter-Phelps DO Sag Model is used to simulate the decay of CBOD and dispersion of total Dissolved Oxygen (DO) in the receiving water downstream from the outfall. The criterion is that the discharge cannot cause the DO level in the receiving stream (warm water) to be below 5.0 mg/l.

The parameter values used in the modeling are listed below:

Background:
The temperature and ammonia nitrogen levels are shown in Table 3. The ultimate CBOD and DO levels are assumed to be 6.0 mg/l and 6.0 mg/l, respectively.

Effluent:
The temperatures are shown in Table 4. The CBOD5 level used in the modeling is 40 mg/l, which is the technology based maximum limit for standard secondary treatment. The ammonia nitrogen values used in the modeling are the calculated toxicity based acute wasteload allocations shown in Table 5a. Both ADW and AWW flows and the ammonia nitrogen limits associated with them are used in the modeling.

Receiving stream parameters:
There is an average water channel slope of 0.00126 (the water channel elevation changes from 898 ft to 870 ft over a distance of approximately 22,310 ft, estimated based on the GIS LiDAR 2-ft contour coverage).

Field Use Attainability Assessment (UAA) had one site along West Branch Indian Creek that was downstream of the outfall. Two observations of stream width, depth, and velocity were made at the site. Based on these UAA data, the stream average width, depth, and velocity at 7Q10 + ADW and 7Q10 + AWW conditions are estimated and are shown in Table 6.

Table 6: Stream Width, Depth, and Velocity

Flow Condition	Flow (cfs)	Width (ft)	Depth (ft)	Velocity (fps)
7Q10 + ADW	2.64	23.0	0.28	0.42
7Q10 + AWW	4.77	24.7	0.36	0.54

Reaeration:
The UAA site on West Branch Indian Creek downstream of the outfall indicated that the stream contains both riffle and run features. Aerial imagery showed that the stream exhibits a moderate amount of meander downstream of the outfall. Therefore, the USGS pool-riffle model (Melching and Flores 1999) is used.

Discussion and conclusion:
The modeling results show that the effluent, which could have an allowed maximum effluent CBOD5 level of 40 mg/l (technology based limits for secondary treatment) and a minimum DO level of 5.0 mg/l, will not cause the DO level in the receiving stream to be below 5.0 mg/l at any time; however, some of the calculated water quality based ammonia nitrogen wasteload allocations, as shown in Table 5a, need to be reduced. The final ammonia nitrogen wasteload allocations are shown in Table 5b.

***E. coli*:**
To protect the Class A2 waterbody:
The water quality standard for *E. coli* in a Class A2 waterbody is a geometric mean of 630 org./100 ml and a sample maximum of 2,880 org./100 ml from March 15th through November 15th. The criteria apply at "end-of-pipe".

To protect the Class A1 waterbody:
The water quality standard for *E. coli* in a Class A1 waterbody is a geometric mean of 126 org./100 ml and a sample maximum of 235 org./100 ml from March 15th through November 15th. *E. coli* decay in West Branch Indian Creek between the outfall and its mouth is taken into consideration. The decay is estimated by using a first order decay model with a length of 23,980 ft, a decay rate of 1.0/day, and a flow velocity of 0.54 fps for 7Q10 + AWW conditions. When *E. coli* decay in West Branch Indian Creek between the outfall and its mouth is taken into consideration, the limits for the protection of the Class A1 waterbody are a geometric mean of 211 org./100 ml and a sample maximum of 393 org./100 ml from March 15th through November 15th.

Final limits:
The limits for the protection of the Class A1 waterbody are more stringent than those for the protection of the Class A2 waterbody; therefore, the limits for the protection of the Class A1 waterbody govern. However, 567 IAC 62.8(2) states that "the daily sample maximum criteria for *E. coli* set forth in Part E of the 'Supporting Document for Iowa Water Quality Management Plans' shall not be used as an end-of-pipe permit limitation." Therefore, only the geometric mean limit of 211 org./100 ml applies.

Chloride and Sulfate:
The chloride and sulfate criteria became effective on Nov. 11, 2009. The default hardness for background and effluent is 200 mg/l.

Chloride criteria are functions of hardness and sulfate concentration, shown as follows:

$$\text{Acute criteria} = 287.8*(\text{Hardness})^{0.205797} *(\text{Sulfate})^{-0.07452}$$
$$\text{Chronic criteria} = 177.87*(\text{Hardness})^{0.205797} *(\text{Sulfate})^{-0.07452}$$

The criteria apply to all Class B waters.

Sulfate criteria, shown in Table 7, are functions of hardness and chloride concentration.

Table 7: Sulfate Criteria

Hardness (mg/l as CaCO3)	Sulfate Criteria (mg/l)		
	Chloride < 5 mg/l	5 mg/l <= Chloride < 25 mg/l	25 mg/l <= Chloride < 500 mg/l
< 100	500	500	500
100<=H<=500	500	(-57.478+5.79*H+54.163*Cl)*0.65	(1276.7+5.508*H-1.457*Cl)*0.65
H> 500	500	2,000	2,000

The criteria defined in Table 7 serve as both acute and chronic criteria and apply to all Class B waters.

The acute criteria apply at the end of the ZID, and the chronic criteria apply at the end of the MZ. In this case, 25% of the 7Q10 flow and 2.5% of the 1Q10 flow in West Branch Indian Creek at the outfall are used as the MZ and the ZID, respectively.

The default chloride concentration for both background water and effluent is 34 mg/l, while the default sulfate concentration for both background water and effluent is 63 mg/l. The limits are calculated based on an assumed sampling frequency of 1/week.

Iron:
The current iron criteria are defined in the 2005 issue paper entitled "Iron Criteria and Implementation for Iowa's Surface Waters (December 5, 2005)". An iron criterion of 1 mg/l applies at the end of the ZID for both general use and designated use streams. In this case, the ZID is 2.5% of the 1Q10 flow in West Branch Indian Creek at the outfall.

pH:
Iowa Water Quality Standards (IAC 567.61.3.(3).a.(2) and IAC 567.61.3.(3).b.(2)) require that pH in Class A or Class B waters "Shall not be less than 6.5 nor greater than 9.0". The criteria apply at the end of the MZ, which is 25% of the 7Q10 flow in West Branch Indian Creek at the outfall. Therefore, the pH in the effluent at the outfall must be between 6.5 and 9.0 Standard Units.

TDS:
Effective Nov. 11, 2009, the site-specific TDS approach is no longer applicable; instead the new chloride and sulfate criteria became applicable. However, the TDS level should be controlled to a level such that the narrative criteria stated in IAC 567.61.3 are fulfilled.

Major Facility Acute WET Testing Ratio:
Use 99.9% of effluent and 0.1% of dilution water for the testing. The ratio is calculated using the ADW design flow and 2.5% of the 1Q10 flow in West Branch Indian Creek at the outfall as the ZID.

5. PERMIT LIMITATIONS:
- *Based on the Year 2006 Water Quality Standards & 2002 Permit Derivation Procedure.*

The acute and chronic WLAs are used as the values for input into the current permit derivation procedure. Under the 2002 permit derivation procedure, only for toxic parameters is the monitoring frequency considered in the calculation of final limits. The water quality based limits are shown on Pages 1 – 3 of this report.

F. Appendix F – Site Survey Approvals

IOWA DEPARTMENT OF NATURAL RESOURCES

GOVERNOR KIM REYNOLDS
LT. GOVERNOR ADAM GREGG
DIRECTOR KAYLA LYON

November 27, 2019

Mr. Matt Mardesen
City Administrator
City of Nevada
1209 6th Street
Nevada, IA 50201

RE: **City of Nevada Wastewater Treatment facility Improvements**
DNR Project #2019-0233A
SUBJECT: **Preliminary Site Investigation & Site Approval**

Dear Mr. Mardesen:

On November 12, 2019 Ms. Anne Hildebrand with the IDNR Field Office in Des Moines, Iowa, conducted a preliminary site investigation for the above-referenced project. The site survey was done in accordance with the Sub rule 567 IAC Chapter 64.2(3) for the proposed wastewater treatment facilities improvements including the construction of the new plant at a new location in Story County, Iowa.

Based upon the site survey report, the site is approvable at this time. Please note that the site approval is preliminary and that further detailed engineering investigations may warrant additional considerations in the future. This approval in no way relieves the Facility from the responsibilities of insuring that the wastewater treatment plant is designed and constructed in accordance with good engineering judgment, and all applicable agency approvals are obtained.

If you have any further questions, please feel free to call me at 515-725-8429 or email me at Suresh.Kumar@dnr.iowa.gov.

Sincerely,

Suresh Kumar, Environmental Engineer/Industrial Coordinator

C: Iowa DNR Field Office 5
City of Nevada Wastewater File 6856200101
Nevada SRF File # CS192094501
HR Green engineering, consultant

THE UNIVERSITY OF IOWA

OFFICE OF THE STATE ARCHAEOLOGIST
700 Clinton Street Building
Iowa City, Iowa 52242
319-384-0732
osa@uiowa.edu
archaeology.uiowa.edu

25 June 2020

Michael Sullivan
Environmental Specialist
Iowa DNR
502 East 9th Street
Des Moines, IA 50319
michael.sullivan@dnr.iowa.gov

RE: Phase I Archaeological Survey, WO 65 DNR Nevada Project, Story County, OSA Technical Report 1326

Dear Mike:

Attached please find the OSA report *Phase I Intensive Archaeological Investigation of the Proposed Nevada Wastewater Treatment Facility Project, Section 31, T83N-R22W, Story County, Iowa,* by Veronica Mraz (TR 1326). As a result of the study no previously recorded archaeological sites were located within the project area and no newly recorded sites were identified. No further archaeological work is recommended in the surveyed areas. The details of our findings are provided in the attached report.

As you know, to complete your archaeological compliance obligations, copies of the enclosed report must also be provided to the appropriate state or federal agencies involved with the project and comment solicited; we assume you will handle this distribution. Keep in mind that agency comments must be received prior to ground-disturbing activities being undertaken within the project area.

The University of Iowa Accounts Payable department will invoice you for this project in about 30 days. If you have any questions, please contact me at 319-384-0937 or via e-mail at william-whittaker@uiowa.edu. Thank you for selecting the OSA for your archaeological service needs and good luck with your project.

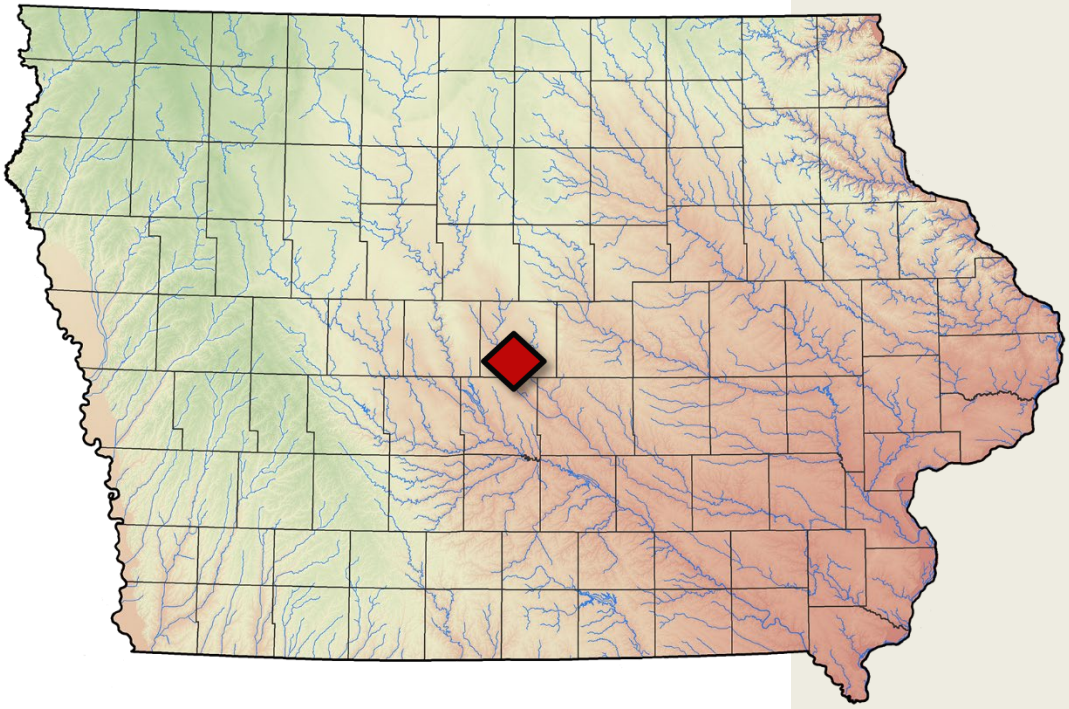
Sincerely,

Bill Whittaker

William E. Whittaker, Ph.D., Research Director

Phase I Intensive Archaeological Investigation of the Proposed Nevada Wastewater Treatment Facility Project, Section 31, T83N-R22W, Story County, Iowa

by Veronica Mraz



Office of the State Archaeologist
The University of Iowa
700 Clinton Street Building
Iowa City, IA 52242

Technical Report 1326
2020

Phase I Intensive Archaeological Investigation of the Proposed Nevada Wastewater Treatment Facility Project, Section 31, T83N-R22W, Story County, Iowa

by Veronica Mraz

William E. Whittaker
Principal Investigator

Prepared for
Iowa Department of Natural Resources
502 East Ninth Street
Des Moines, IA 50319

Contract: 20ESDWQBSKONR-0001
DNR Work Order 065

Prepared by
Office of the State Archaeologist
The University of Iowa
700 Clinton Street Building
Iowa City, IA 52242

Technical Report 1326
June 25, 2020

Information contained in this report relating to the nature and location of archaeological sites is considered private and confidential and not for public disclosure in accordance with Section 304 of the National Historic Preservation Act (54 U.S.C. § 307103); 36 CFR Part 800.6 (a)(5) of the Advisory Council on Historic Preservation's rules implementing Sections 106 and 110 of the Act; Section 9(a) of the Archaeological Resource Protection Act (54 U.S.C. § 100707) and Chapter 22.7 § 20 of the Iowa Code

Abstract

A Phase I intensive archaeological survey was conducted by the University of Iowa Office of the State Archaeologist at the location of the proposed Nevada wastewater treatment facility, Story County, Iowa. The field investigation was conducted on May 26–30, 2020. No artifacts or archaeological features were identified in the survey of the 60 ac parcel. No further archaeological investigation of the area surveyed prior to the proposed project activities is recommended.

Introduction

The Office of the State Archaeologist (OSA) of the University of Iowa has prepared this report under the terms of a cultural resource survey agreement between OSA and Iowa Department of Natural Resources of Des Moines, Iowa. This report records the results of a Phase I archaeological investigation of the proposed Nevada wastewater treatment facility. This project area is situated in the uplands and into the West India Creek valley, in Section 31, T83N-R22W, Story County, Iowa (Figures 1–4). The proposed project involves the construction of four buildings, two ditches, two storage tanks, a pump station with the associated piping, structures, and access road. The area surveyed includes a cultivated field and creek tributary, spanning 25 ha (60 ac).

The Phase I investigation was conducted on May 26–30, 2020 by Veronica Mraz and Dustin Clark and took 54 person hours in the field. Mraz served as report author and William Whittaker served as project director.

The OSA is solely responsible for the interpretations and recommendations contained in this report. All records including maps and figures are curated in the OSA Archives. The National Archeological Data Base Form is included as Appendix I.

Information contained in this report relating to the nature and location of archaeological sites is considered private and confidential and not for public disclosure in accordance with Section 304 of the National Historic Preservation Act (54 U.S.C. § 307103); 36 CFR Part 800.6 (a)(5) of the Advisory Council on Historic Preservation's rules implementing Sections 106 and 110 of the Act; Section 9(a) of the Archaeological Resource Protection Act (54 U.S.C. § 100707) and, Chapter 22.7 § 20 of the Iowa Code.

Geomorphological Context

The proposed project is located within the Iowa landform region known as the Des Moines Lobe. This region is underlain by glacial till deposited during the most recent ice advances into Iowa, approximately 12,000 to 14,000 years ago. The Bemis, Altamont, and Algona end moraines delimit the three major Late Wisconsinan glacial ice margins. The surface of the Des Moines Lobe lacks a Wisconsinan loess mantle (Prior 1991:39–40, 47). Except along major streams, drainage systems are generally not well established. Kettle lakes, eskers, kames, and other features formed by ice wasting and meltwater discharge mark the landscape. Though many wetlands have been drained, the majority of Iowa's natural lakes are located in the region. The Des Moines River and its immediate tributaries deeply incise the till plain, exposing the underlying bedrock in many places.

Holocene alluvial valley fills in Iowa are subdivided on the basis of lithology and stratigraphic relationships into the Gunder, Corrington, Roberts Creek, and Camp Creek members of the DeForest formation (Bettis and Littke 1987). Gunder member alluvium and Corrington member alluvial fans may

contain Paleoindian through Woodland components; Roberts Creek member deposits may contain Late Archaic through early historic components; and Camp Creek member alluvium may contain buried and unburied historic archaeological components, and may bury older surfaces. Three additional DeForest formation members are specific to the Des Moines Lobe. The Flack member is composed of colluvium at the base of hillslopes as a result of sheet wash, rill erosion, and mass movement on upland hillslopes. Deposition is time regressive, dependent on landscape position and factors affecting hillslope stability. The Woden member consists of alternating zones of fine-grained colluvium and organic sediment on semi-closed and closed depressions. The West Okoboji member is composed of sediments associated with the extant lakes on the Des Moines Lobe (Bettis et al. 1996).

Environmental Context

The project area is situated on the southeastern edge of the Des Moines Lobe landform region and associated moraines. The area is in the W½, NE¼ and the SE¼, NE¼ of Section 31, T83N-R22W, Story County, Iowa, 4.5 km south of the City of Nevada and Iowa Highway 30, at an elevation range of 910–960 ft above mean sea level (Figures 1–4). At the time of survey, the project area was a planted agricultural soybean field. The parcel consisted of an irregular area measuring 800 x 500 m in maximum extent. Project area entrances, staging areas, and material storage areas will be within surveyed areas or on nearby paved areas.

Soils of the project area are mapped as Zenor, Clarion, Storden, Coland, Terril, Nicollet, Estherville, and Spillville (Figure 3; Table 1; Artz 2005; DeWitt 1984; USDA 2020). Terril soils series are a part of the Gunder or Corrington Members, which can contain a buried soil, that were typically deposited between 9,000 and 2,500 years BP. These soils can have a high potential for containing archaeological sites. Coland soil series is described as Roberts Creek or Gunder Member. These soils describe DeForest Formation sediments with a gradational contact between the two members with Roberts Creek above the Gunder Member. Roberts Creek sediments were generally deposited between 4,000 and 500 years BP and the Gunder Member has a date range between 10,500 to 3,000 years BP, which provides a high potential for these soils to contain archaeological sites. Spillville soil series is listed as part of the Roberts Creek Member, which is usually Late Holocene in age (4,000–500 years BP). Roberts Creek soils have a high potential to preserve archaeological remains.

Soils in upland settings, such as Zenor and Clarion, have relatively shallow archaeological potential when the parent material predates the earliest human occupation of Iowa and Holocene-aged surface deposition is slow or absent. Movement of artifacts within the soil column is restricted to biologically active horizons. If there is adequate ground surface visibility, larger archaeological sites in plowed upland soils will generally display surface artifacts. Shallow subsurface deposits may exist in unplowed upland areas, and the bottoms of deep human-dug features may be preserved even in plowed areas. Subsurface archaeological testing within these upland settings is usually terminated below the biologically active zone as indicated by the presence of a pedologically formed subsoil (B horizon), relatively unaltered parent material (C horizon), or bedrock (R horizon).

The Landscape Model for Archaeological Site Suitability (LANDMASS) is a useful tool for predicting the suitability of a particular upland landform position for prehistoric habitation (Artz et al. 2006; Riley et al. 2011). The ranking is divided into three suitability rankings: low, moderate, and high, based on logistic regression statistical analysis of how often sites have been found in areas with topographically similar terrain. Based upon the model, the project area is located on a landform with a moderate prehistoric suitability ranking. It is important to note that this predictive model is limited to upland landforms and does not include alluvial settings, such as river valleys and drainages.

Historical and Cultural Context

The Iowa Site Record at OSA, records of previous archaeological surveys nearby (OSA 2020), the National Register Information System web site (National Park Service 2020), the Andreas atlas of Iowa (Andreas 1875), and Story County plat books (Hixson 1930; Huebinger 1902; Kenyon 1919, 1926; Nevada Representative 1908; Warner and Foote 1883) were reviewed for this survey. Other consulted resources included the 1847 General Land Office survey map (ISUGISRF 2020; U.S. Department of the Interior 2020), the Historic Indian Location Database (HILD), and the OSA Notable Locations database of cemeteries and poorly located historic or archaeological locations (Whittaker 2016, 2020).

Historic documentation revealed no buildings or other improvements within the project area, and there are no standing buildings or structures located within the project area (Figures 4–9).

There are four archaeological sites recorded within 1.6 km (1 mi) of the project area: 13SR230, 13SR231, 13SR232, and 13SR233, all prehistoric isolated finds described in detail below. The nearest survey was Martin et al. (2010), located 0.1 km to the east. No sites were recorded near the project area in Martin et al. survey. The HILD reveals no documented historic Native American use of the project area or nearby areas. The Notable Locations database shows one nearby suspected archaeological or historical locations (ID: XX574, possible mounds, located approximately 1.3 km to the northeast).

Site 13SR230 is a prehistoric isolated surface find, located in the SE¼, SW¼ Section 31, T83N-R22W. This site has not been evaluated for the National Register of Historic Places (NRHP). This site was recorded by a private collector, Jimmie Thompson. This site consists of one projectile point and nine lithic chips and chunks. These artifacts were scattered on a south facing hillside terrace several feet above the point of the junction of the flood plains of West Indian Creek and Grant Creek (ditch).

Site 13SR231 is a prehistoric isolated surface find, located in the SE¼, SW¼ Section 31, T83N-R22W. This site has not been evaluated for the NRHP. This site was recorded by a private collector, Jimmie Thompson. This site consists of one scraper, one broken projectile point, and 24 lithic chips and chunks. This site is located on the eastern side of a hillslope adjacent to the west side of Grant Creek (ditch) floodplain.

Site 13SR232 is a prehistoric isolated surface find, located in Section 31, T83N-R22W. This site has not been evaluated for the NRHP. This site was recorded by a private collector, Jimmie Thompson. This site consists of one projectile point, one scraper, and 24 lithic chips and chunks. This site is located on a floodplain between the West Indian Creek and Grant Creek (ditch).

Site 13SR233 is a prehistoric isolated surface find, located in Section 31, T83N-R22W. This site has not been evaluated for the NRHP. This site was recorded by a private collector, Jimmie Thompson. This site consists of five lithic chips and chunks. This site is located west of West Indian Creek and east of an artificial pond.

Archaeological Assessment

METHODS

Ground surface visibility was adequate for pedestrian survey, at 75%. The entire project area was investigated through 10 m interval pedestrian survey. Six soils cores were placed across the upland landforms to verify soil type and determine degree of soil erosion or disturbance. Across the creek terrace six 20 cm diameter auger tests were excavated in a linear transect at 30 m intervals to test for archaeological deposits in buried soils (Figure 4). Auger test soils were removed in arbitrary 10 cm levels to examine soil stratigraphy and were screened with ¼ in hardware cloth. Soils were described using the conventions of Schoeneberger et al. (2012) and Vogel (2002). Maximum test depth was 150 cm.

RESULTS

Several modern bricks, indeterminate pieces of metal, and modern glass artifacts were observed on the surface but are not demonstrably older than 50 years and no buildings or structures were recorded historically in the area. It is likely that these items were brought into the field through typical farming activities such as manure spreading. Soil cores revealed a highly eroded soil profile consisting of a deflated plow zone overlying weak B subsoil horizons.

No artifacts were recovered in auger tests. Auger Test 1 in the southeast part of the survey area revealed a surface comparable to Spillville, comprised of several A loam horizons overlying a dark grayish brown loam C horizon (Tables 1 and 2, Figure 4). None of the auger tests or cores encountered buried A horizons or other buried surfaces suitable for habitation.

Management Recommendations

The Phase I archaeological survey by the OSA of a proposed Nevada wastewater treatment facility project revealed no archaeological material or other cultural deposits. The project area was investigated through pedestrian survey, six soil cores, and six auger tests. The surface of the project area contained glacial till, modern bricks and glass, and short soybean plants. Because of this absence of cultural resources older than 50 years of age, no further archaeological work for this project is recommended.

No technique is completely adequate to locate all archaeological materials, especially deeply buried ones. Therefore, should any cultural, historical, or paleontological resources be exposed as part of proposed project activities, the responsible agency must be notified immediately in accordance with the Protection of Historic Properties regulations of the Advisory Council on Historic Preservation [36 CFR Part 800.13(b)]. If human remains are accidentally discovered, Iowa burial law [Code of Iowa, Sections 263B, 523I.316(6), and 716.5; IAC 685, Ch.11.1] requires that all work in the vicinity of the finding be halted, the remains protected, local law enforcement officials notified, and the Bioarchaeology director at the OSA contacted immediately (319-384-0740). Archaeologists with the OSA (319-384-0937) and the State Historical Society of Iowa (515-281-8744) are also available to consult on issues of accidental discovery.

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Table 1. Project Area Mapped Soils.

Soil Name	ID	Description	I-Sites LSA[1]	Landform	Native Vegetation	Pedon
Clarion	138B1, 138C2	1–9% slopes; very deep, moderately well drained, formed on glacial till	Glacial till	Uplands	Tall grass prairie	Ap-A1-A2-Bw1-Bw2-C1-C2
Coland	201B1	0–5% slopes; very deep, poorly drained formed in alluvium	Roberts Creek/Gunder	Floodplains, alluvial fans in river valleys and upland drainageways	Wet tolerant tall grass prairie	Ap-A1-A2-AB-Bg1-Bg2-Cg
Estherville	34C1	0–70% slopes; very deep, drained soils over sandy and gravelly outwash	Glaciofluvial	Outwash plains, stream terraces, valley trains, and kames on moraines	Tall grass prairie	Ap-A-Bw1-2Bw2-2C1-2C2
Nicollet	55A1	0–5% slopes; very deep, poorly drained, formed in glacial till	Glacial till	Till plains and moraines	Tall grass prairie	Ap-A-B2-Bg1-Bg2-BCg-BCkg
Spillville	485A	0–5% slopes; very deep, moderately drained soils formed in alluvium	Roberts Creek	Floodplains and foot slopes on uplands	Tall grass prairie	A1-A2-A3-C
Storden	62D3, 62E3, 62E1	4–70% slopes; very deep, well drained soils formed in glacial till	Glacial till	Glacial moraines	Tall grass prairie	Ap-Bk1-Bk2-C
Terril	201B1, 8027B1	0–25% slopes; very deep, well drained soils formed in colluvium	Gunder or Corrington	Base slopes, foot slopes, drainageways, swales, toe slopes on alluvial fanes, treads and risers on stream terraces	Tall grass prairie	Ap-A1-A2-A3-A4-Bw1-Bw2-BC
Zenor	828B1	2–30% slopes; very deep, excessively drained soils formed in glacial outwash	Glaciofluvial	Uplands and stream benches	Tall grass prairie	Ap-AB-Bw1-Bw2-BC-C1-C2-C3

[1] Landform/Sediment Assemblage (Artz 2005).

Table 2. Representative Soil Profiles.

Location	Depth (cm)	Description
Soil Core 1	0–17	Ap horizon of very dark gray (10YR 3/1) sandy loam; common fine roots; weak subangular blocky structure; clear boundary.
	17–45	Bw1 horizon of brown (10YR 4/3) sandy clay loam; weak subangular blocky structure; clear boundary.
	45–70	Bw2 horizon of brown (10YR 5/3) to yellowish brown (10YR 5/4) sandy clay loam; pebbles; weak subangular blocky structure.
Soil Core 2	0–20	Ap horizon of very dark brown (10YR 2/2) sandy loam; common fine roots; sand lens at 20 cm; weak subangular blocky structure; gradual boundary.
	20–45	Bw1 horizon of dark yellowish brown (10YR 3/4) mottled with light yellowish brown (10YR 6/4) sandy clay loam; weak subangular blocky structure; gradual boundary.
	45–90	Bw2 horizon of yellowish brown (10YR 5/6) mixed with dark yellowish brown (10YR 4/6) sandy clay loam; weak subangular blocky structure.
Soil Core 3	0–25	Ap horizon of very dark gray (10YR 3/1) sandy loam; common fine roots; weak subangular blocky structure; gradual boundary.
	25–45	Bw1 horizon of dark yellowish brown (10YR 3/4) to dark yellowish brown (10YR 3/6) sandy clay loam; pebbles; subangular blocky structure; gradual boundary.
	45–80	Bw2 horizon of yellowish brown (10YR 5/4) to yellowish brown (10YR 5/6) sandy clay; subangular blocky structure.
Soil Core 4	0–5	Ap horizon of very dark gray (10YR 3/1) sandy loam; common fine roots; gradual boundary.
	5–20	Ap/A horizon of dark yellowish brown (10YR 3/4) sandy loam; common fine roots; weak subangular blocky structure; gradual boundary.
	20–25	Bw1 horizon of dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4) sandy clay loam; subangular blocky structure; gradual boundary.
	25–45	Bw2 horizon of yellowish brown (10YR 5/4) to yellowish brown (10YR 5/8) sandy clay loam; subangular blocky structure.
Soil Core 5	0–20	Ap/AB horizon of dark yellowish brown (10YR 4/4) to dark yellowish brown (10YR 4/5) sandy loam; common fine roots; weak subangular blocky structure; clear boundary.
	20–75	C1 horizon of yellowish brown (10YR 5/4) to yellowish brown (10YR 5/6) with light yellowish brown (10YR 6/4) sand; granular; clear boundary.
	75–80	C2 horizon of brownish yellow (10YR 6/6) fine sand; granular.
Soil Core 6	0–20	Ap horizon of very dark grayish brown (10YR 3/2) sandy clay loam; common fine roots; pebbles; weak subangular blocky structure; clear boundary.
	20–30	Bw horizon of dark yellowish brown (10YR 3/4) to dark yellowish brown (10YR 4/6) sandy clay loam; pebbles; subangular blocky structure; hit rock.
Auger Test 1	0–20	Ap horizon of black (10YR 2/1) sandy loam; fine common roots; pebbles; weak subangular blocky structure; gradual boundary.
	20–75	A horizon of very dark grayish brown (10YR 3/2) sandy loam; faint redox; weak subangular blocky structure; clear boundary.

Location	Depth (cm)	Description
Auger Test 1, cont.	75–90	Bw1 horizon of very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2) sandy clay loam; subangular blocky structure; faint redox; hit water table at 80cm; gradual boundary.
	90–140	Bw2 horizon of dark grayish brown (10YR 4/2) sandy clay loam; subangular blocky structure; gradual boundary.
	140–150	Bw3 horizon of dark yellowish brown (10YR 4/6) very sandy clay loam; subangular blocky structure.
Auger Test 3	0–25	Ap horizon of black (10YR 2/1) sandy loam; fine common roots; pebbles; weak subangular blocky structure; gradual boundary.
	25–75	A horizon of very dark grayish brown (10YR 3/2) sandy loam; faint redox; weak subangular blocky structure; hit the water table at 60 cm; clear boundary.
	75–85	Bw1 horizon of very dark grayish brown (10YR 3/2) to dark grayish brown (10YR 4/2) sandy clay loam; subangular blocky structure; faint redox; gradual boundary.
	85–95	Bw2 horizon of dark grayish brown (10YR 4/2) sandy clay loam; subangular blocky structure.
Auger Test 6	0–20	Ap horizon of very dark grayish brown (10YR 3/2) sandy loam (wet); sand lens 18–19 cm; weak subangular blocky structure; gradual boundary.
	20–55	A horizon of very dark gray (10YR 3/1) sandy loam; iron redox; subangular blocky structure; clear boundary.
	55–60	? horizon of dark grayish brown (10YR 4/2) to brown (10YR 4/3) sand; granular; clear boundary.
	60–80	Bw1 horizon of very dark gray (10YR 3/1) sandy clay loam; iron redox; subangular blocky structure; clear boundary.
	80–110	Bw2 horizon of dark gray (10YR 4/1) to dark grayish brown (10YR 4/2) sandy clay loam; iron redox; subangular blocky structure.

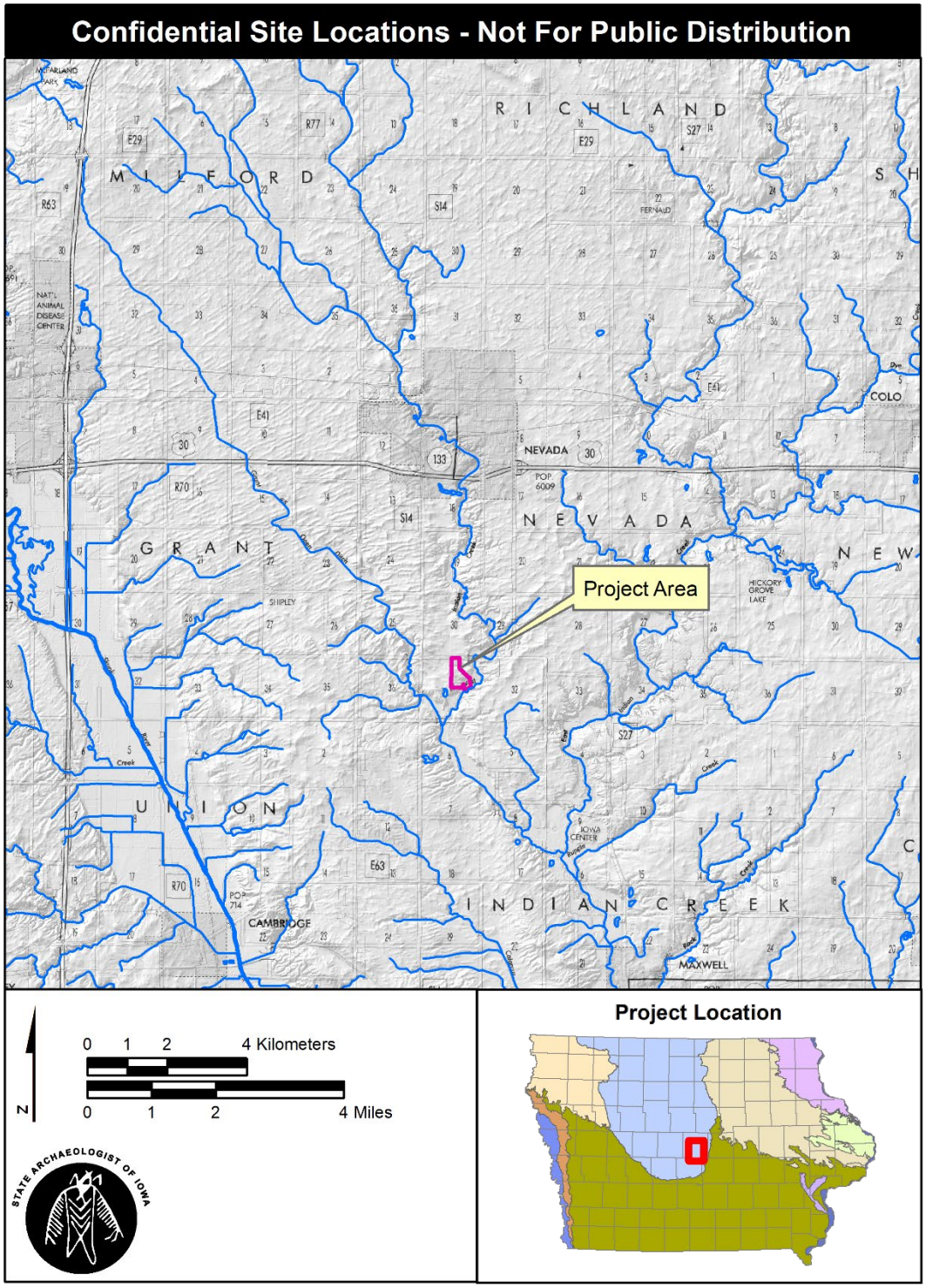

Figure 1. Project location.
From ISUGISSRF (2020).

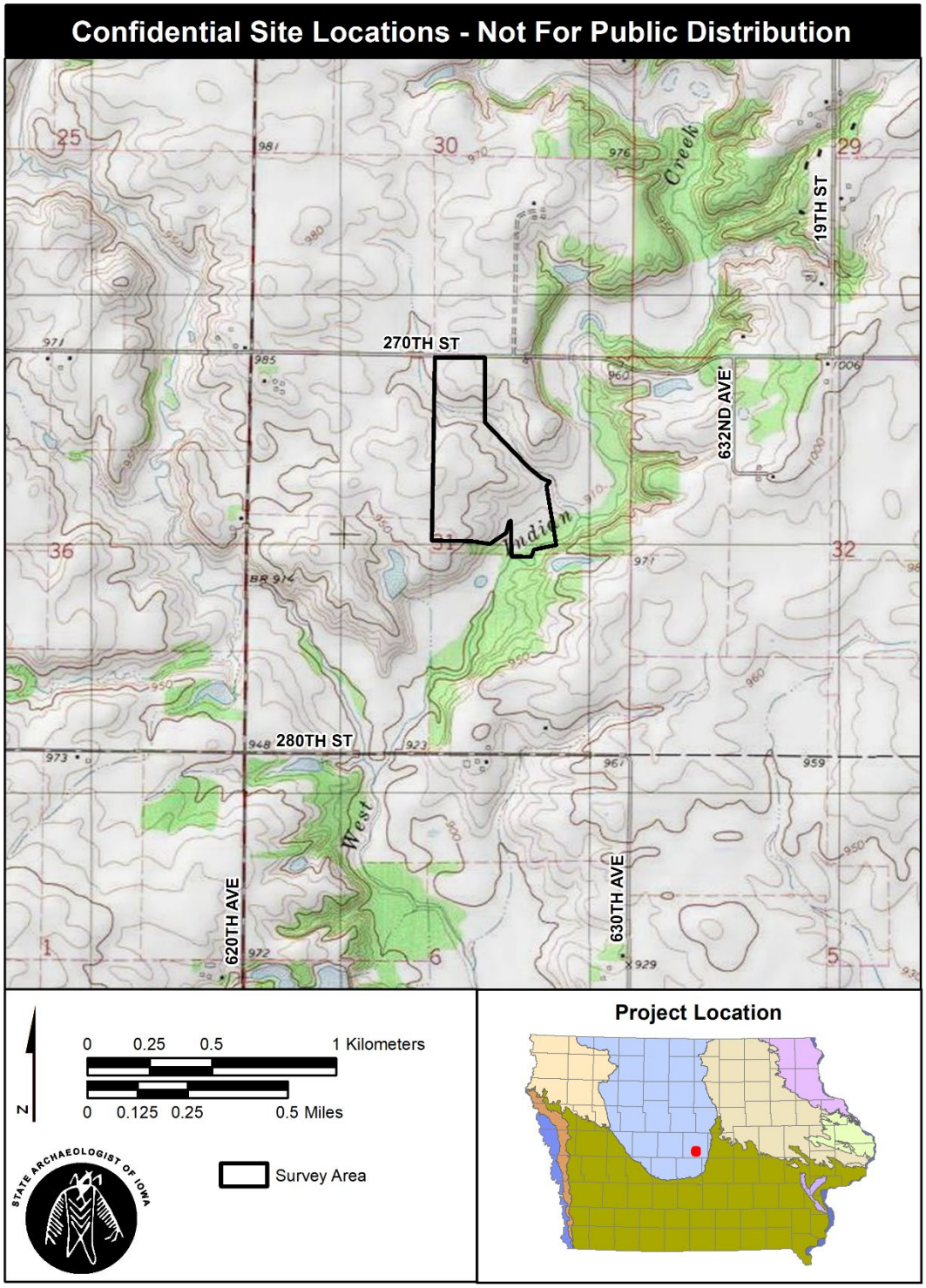

Figure 2. Project location in relation to surrounding topography.
From USGS Maxwell (1975), 7.5' series quadrangle map. Scale 1:24,000.

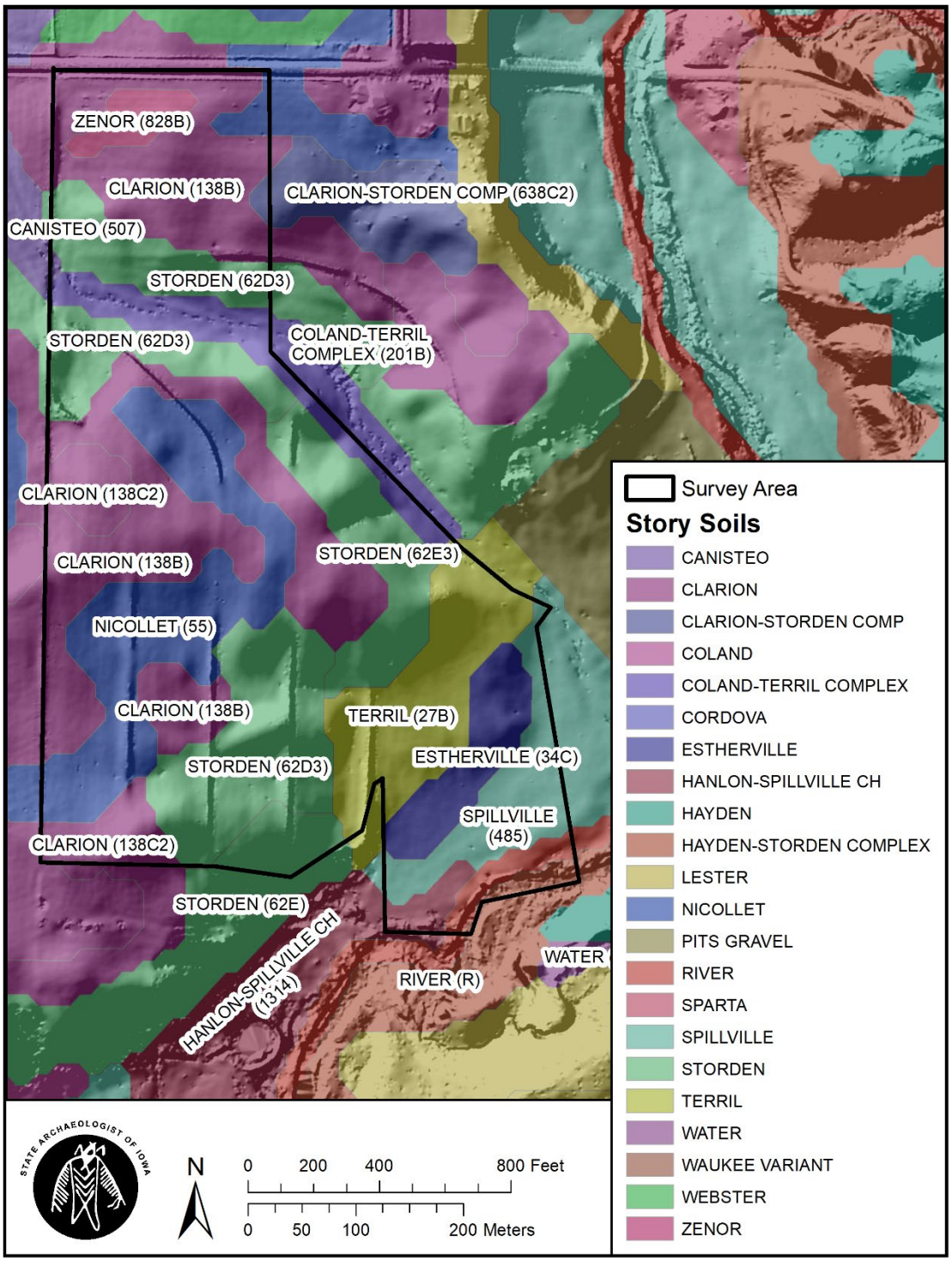

Figure 3. Project location in relation to mapped soil type.
From Iowa Cooperative Soil Survey digitization of Story County, base image is lidar 1-m hillshade map (ISUGISSRF 2020).

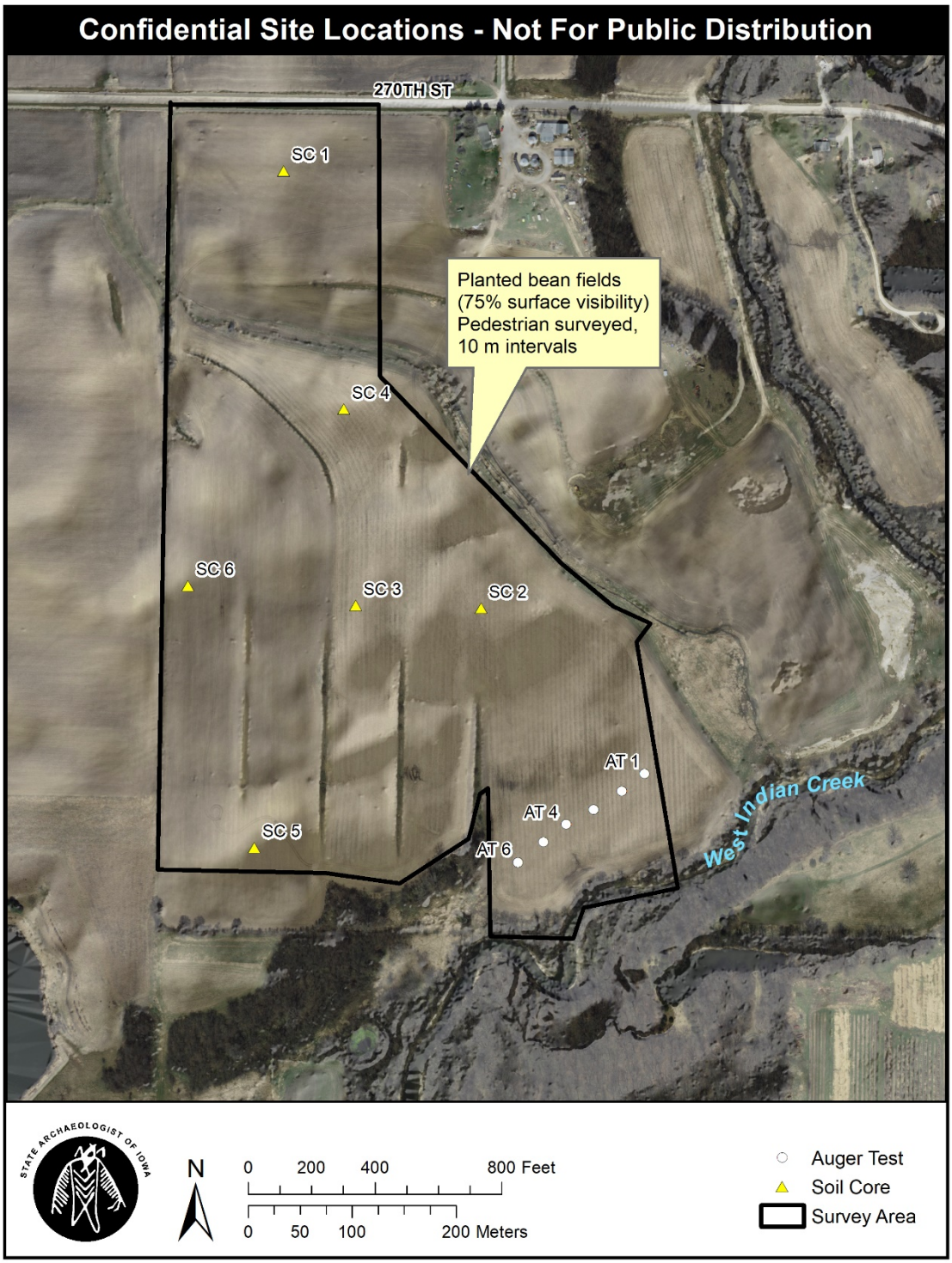

Figure 4. Detail map of project area showing subsurface test locations. Base aerial image: ISUGISRF (2020).

Figure 5. Project area photographs.
Upper: facing north from the northern portion of the project area showing Dustin Clark conducting pedestrian survey. Lower: facing north from the southeast part of the project area.

Figure 6. Project area photographs.
Upper: facing north from the southwest corner of the project area. Lower: facing south taken from the southwest corner of the project area.

Figure 7. Project area photographs.
Upper: facing southeast taken from the western edge of the project area. Lower: facing east from the western edge of the project area.

Figure 8. Project area photographs.
Upper: facing east from the southeast sector or the project area. Lower: facing west from the eastern edge of the project area.

Figure 9. Project area photograph, facing west from the middle of the project area.

Appendix I: National Archeological Data Base - Reports: Data Entry Form

Complete items 3 and 5-14. The State Historic Preservation Office will record information for items 1 through 4.

1. DOCUMENT NO. _____

2. SOURCE _____ AND SHPO – ID _____

3. FILED AT
Office of the State Archaeologist
700 CLSB
University of Iowa
Iowa City, IA 52242

4. UTM COORDINATES

Zone _____Easting_____Northing_____
Zone _____Easting_____Northing_____
Zone _____Easting_____Northing_____
Zone _____Easting_____Northing_____
Zone _____Easting_____Northing_____
Zone _____Easting_____Northing_____

Continuation, see 14.

5. AUTHORS Veronica Mraz

6. YEAR 2020 (year published)

7. TITLE Phase I Intensive Archaeological Investigation of the Proposed Nevada Wastewater Treatment Facility Project, Section 31, T83N-R22W, Story County, Iowa

7. PUBLICATION TYPE (circle one)
4. Report Series

9. INFORMATION ABOUT PUBLISHER/PUBLICATION
Follow the American Antiquity style guide for the type of publication circled.

Technical Report 1326 Office of the State Archaeologist, The University of Iowa, Iowa City.

10. STATE/COUNTY (Referenced by report. Enter as many states, counties, or towns, as necessary. Enter all, if appropriate. Only enter Town if the resources considered are within the town boundaries.)

STATE 1 Iowa COUNTY Story TOWN T83N-R22W

11. WORKTYPE [32] PHASE I

12. KEYWORDS and KEYWORD CATEGORIES

Enter as many keywords (with the appropriate keyword category number) as you think will help a person (1) who is trying to understand what the report contains or (2) who is searching the database for specific information. Whenever appropriate, record the number of acres studied in a document.

[6] Project Area: 60 acres [ ]
[ ] [ ]

13. FEDERAL AGENCY

14. CONTINUATION/COMMENTS (include item no.)

FORM COMPLETED BY

Name Angela Collins Date June 24, 2020

Address Office of the State Archaeologist
700 CLSB
University of Iowa

City Iowa City State IA

Zip 52242

Telephone Number 318-384-0937

G. Appendix G – Stormwater Management Manual

HRGreen

HRGREEN.COM

Stormwater Management Plan

August 12, 2020

HR Green Project No: 160473

Prepared for:

City of Nevada and Story County

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Storm Sewer 1
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Detention 3

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Appendix A: Geotechnical Engineering Report
Appendix B: Existing Topography
Appendix C: Proposed Site Conditions and Topography
Appendix D: Floodplains

Purpose

This stormwater management plan details the site conditions and modifications to meet the requirements set forth by Story County and the Iowa Stormwater Management Manual. The City of Nevada proposes to replace the existing Wastewater Treatment Facility. The existing Wastewater Treatment Facility has insufficient capacity for projected loadings, no nutrient removal capability with existing processes and nearing the end of its useful lifetime. The existing facility has insufficient space to expand the treatment and thus is being relocated to a city-owned site approximately 3.5 miles to the south of the existing wastewater treatment facility.

Methodology

Culvert

Streamstats was used to determine the flow experienced at the upstream end of the proposed culvert system. To ensure that the access road to the wastewater treatment plan, SUDAS guidelines were referenced for the design of the culvert system. SUDAS states that the headwater of the culvert system should not exceed 1 foot below the lowest point of the roadway. Headwater elevations were determined using HY-8 Version 7.50.

Storm Sewer

Rational method was used to determine the pipe sizes for the storm sewers. A significant amount of flow draining to the storm sewers will be added via the roadway ditches aimed to capture the offsite drainage. To ensure that the ditches do not fill up with water, the storm sewer pipes were sized to accommodate flows up to the 100-year design storm. Runoff coefficients were determined by utilizing the results of the geotechnical engineering report. The existing ground and soil data are classified as a poorly drained agricultural field with grass and crop stubble.

Detention

To protect stream channels, the site shall be designed to provide 24-hours of extended detention of the channel protection volume determined for the 1 year, 24-hour storm. To accomplish this, runoff is collected on-site to temporarily store excess runoff. An outfall structure is designed to limit the rate of flow being discharged from the detention area. The outflow rate will be lower than the inflow rate, thus collecting water within the detention area. The detention area shall be large enough to contain the post construction 100-year, 24-hour event and the outlet structure should release at the 5-year, 24-hour storm pre-construction rate. Sizing for the outlet structure was calculated using HydroCAD.

Existing Conditions

The project is located approximately 1.0 miles east of 620th Ave. Per Story County standards, the site soil conditions are to be classified by County Soil Maps. The County Soil Maps located on the NRCS website have not been updated since 1903. To provide more accurate soil data, a geotechnical engineering report was conducted. The report concluded that the existing ground cover is an agricultural field with grass and crop stubble. The existing grades generally slope down from west to east across the site with about 40 feet of total elevation change. An existing swale/drainage way runs northwest to southeast and is located immediately north of the proposed treatment plant. The project site is located near the eastern boundary of a geomorphic region known as the ‘Des Moines Glacial Lobe.” Recent deposits consist of poorly drained material.

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Proposed Solution

Culvert

The new facility is located immediately south of a blue line drainage way according to streamstats. To ensure that flow is not blocked due to the new construction, a triple-54" culvert is being installed along the natural drainage way to convey flow and ultimately outlet to West Indian Creek. The flows for the various storm event were provided by streamstats and the pipe capacity and headwater elevations were calculated using HY-8 Version 7.50. SUDAS standards for roadway crossing state that the 100-year storm event should be conveyed through the culvert without the headwater depth exceeding 1 foot below the low point of the roadway.

TABLE 1: STREAMSTATS FLOWS (CFS)

Storm Event	Flow (cfs)
2-Year	35.10
5-Year	93.20
10-Year	149.00
25-Year	232.00
50-Year	301.00
100-Year	377.00
200-Year	463.00
500-Year	562.00

TABLE 2: HY-8 RESULTS BASED ON STREAMSTATS FLOWS

	Pipe Invert (elev)	Pipe Size (in)	Pipe Type	Headwater Elev (ft)	Velocity (ft/s)
10-Year	942.00	Triple 54"	RCP	944.92	11.35
50-Year	942.00	Triple 54"	RCP	946.58	13.28
100-Year	942.00	Triple 54"	RCP	947.47	14.00

Storm Sewer

The proposed facility design includes a loop roadway which will require additional culverts to maintain drainage pathways to either the existing drainage swale or West Indian Creek. Flows used to determine the culvert size were calculated using rational method. The runoff coefficients for the drainage areas were determined by using the soil and ground cover data as reported by the geotechnical engineering report. The existing ground cover and soil data is noted as poorly drainage agricultural field with grass and crop stubble. The site will also utilize roadway ditches to concentrate and convey the flow to a centralized low point. To ensure that the pipes could adequately drain these low points, the pipes were sized to convey the 100-year flow. The intakes at the low point will be the only constraint, however the ditches have enough capacity to store the 100-year storm event.

TABLE 3: PROPOSED STORM SEWER

	Size (in)	Slope (%)	Pipe Capacity (cfs)	Q Calculated (cfs)
STP-1	30 Arch			22.53
STP-2	24			

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STP-3	15	1.91%	8.93	0.18
STP-4	24	0.50%	16.00	11.42
STP-5	30	0.47%	28.12	21.09
STP-6	15	1.05%	6.62	4.62
STP-7	30	0.60%	31.77	26.08
STP-8	36	1.43%	79.76	71.20

Detention

The new facility will create more impervious area than existing on the current site. Due to the increased impervious area, there is a need for increased detention onsite. Detention calculations and sizing will follow the guidelines set forth by the Iowa Stormwater Management Manual and the Chapter 88 standards provided by Story County.

The stormwater management guidelines provided by Story County state that "stormwater management shall be provided to limit the post development rate of runoff from the site area during the 5-year through the 100-year, 24 hour storm events to the lesser of the following values: runoff rates equivalent to those from a storm event of the same intensity and duration based on predeveloped conditions or runoff rates equivalent to those from the 5-year storm event based on conditions which exist as of the date of the proposed improvements plan." The detention basin is designed to provide 24-hours of extended detention for the channel protection volume (1-year, 24-hour storm). The basin's design will feature a multi-stage outlet structure sized to restrict outlet flow. The restricted flow will mimic natural hydrology during small storm events, therefore reducing the potential for channel erosion.

TABLE 4: DETENTION REQUIREMENTS

	Curve Number	North Detention Basin		South Detention Basin	
		Area (Ac)	Volume (cf)	Area (Ac)	Volume (cf)
Pre-development	85	5.15	53,328	15.67	162,262
Post-development	95	5.15	56,887	15.67	173,091

The proposed detention design will satisfy the requirements for the water quality volume (WQv) and the channel protection volume (CPv). The design rainfall depth to be used for determining the WQv in Iowa is 1.25 inches. Design calculations for WQv can be found in Chapter 2 of the Iowa Stormwater Management Manual (ISWMM). The channel protection volume can be determined using TR-55 with rainfall depths for 1-year, 24-hour storm event (2.73 inches at the project site). Rainfall depths for the project were determined using NOAA Rainfall Data. Both the WQv and the CPv were calculated for the entire site and distributed between the two detention basins as both detention basins will outlet to West Indian Creek.

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TABLE 5: IMPERVIOUS STRUCTURES BREAKDOWN

Structure Type	Area (cf)	% Impervious
Buildings / Structures	17922	100
Sidewalks	8904	100
Driveways / Pads	35524	100
Access Drive	86039	100
Open Top / Non-Impervious	71546	0
Gravel	3337	100

TABLE 6: WATER QUALITY AND CHANNEL PROTECTION VOLUMES FOR PROPOSED DESIGN

	Volume (cf)
Water Quality Volume	15,074
Channel Protection Volume	40,511

The multi-stage outlet design for the detention basin will have a release rate equal to the runoff rate of the 5-year, 24-hour storm event under pre-developed conditions. The bottom surfaces of the detention basin will hold the WQv and the CPv. The outlet structure elevation will have outlets for the low flow storm events as well as outlets to release the larger storm events at the rate of the small storm events. The outlet structure will also contain an overflow outlet for the storms larger than the 100-year, 24-hour storm event.

TABLE 7: DETENTION BASIN KEY ELEVATIONS

	North Detention Basin	South Detention Basin
Basin Bottom Elevation		
WQv Elevation		
CPv Elevation		
5-Year Pre-developed Outlet Elevation		
100-Year Post-developed Overflow Elevation		

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Appendix A

DRAFT

Geotechnical Engineering Report

Nevada Wastewater Treatment Facility
Nevada, Iowa
May 22, 2020
Terracon Project No. 08205065-01

Prepared for:
HR Green, Inc.
Johnston, Iowa 50131

Prepared by:
Terracon Consultants, Inc.
Des Moines, Iowa

May 22, 2020

HR Green, Inc.
5525 Merle Hay Road
Johnston, Iowa 50131

Attn: Mr. Michael Roth, P.E. – Senior Project Manager
P: (515) 657 5304
E: mroth@hrgreen.com

Re: Geotechnical Engineering Report
Nevada Wastewater Treatment Facility
T83N, R22W, NE ¼ Section 31, Nevada Township
Nevada, Iowa
Terracon Project No. 08205065-01

Dear Mr. Roth:

We have performed geotechnical engineering services for the referenced project in general accordance with Terracon Proposal No. P08205065 dated March 18, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Mark A. Jacobsen II, P.E.
Senior Engineer

Kole C. Berg, P.E.
Senior Associate / Senior Engineer

REPORT TOPICS

INTRODUCTION 1
SITE CONDITIONS 1
PROJECT DESCRIPTION 2
GEOTECHNICAL CHARACTERIZATION 6
GEOTECHNICAL OVERVIEW 10
EARTHWORK 12
SHALLOW FOUNDATIONS 21
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SEISMIC CONSIDERATIONS 25
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GENERAL COMMENTS 33
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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLAN
EXPLORATION RESULTS
- GeoModels
- Boring Logs (D1 through D10, S1 through S9, and V1 through V5)
- Grain Size Distribution

SUPPORTING INFORMATION
- General Notes
- Unified Soil Classification System

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Nevada Wastewater Treatment Facility

Nevada, Iowa

Terracon Project No. 08205065-01

May 22, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Nevada Wastewater Treatment Facility to be located south of Nevada, Iowa. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Lateral earth pressures
- Foundation design and construction
- Floor slab design and construction
- Seismic site class per IBC
- Dewatering considerations
- Frost considerations

The geotechnical engineering Scope of Services for this project included the advancement of twenty-four (24) test borings to depths ranging from approximately 15½ to 50½ feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location and Exploration Plan** section. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in **Exploration Results**.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	▪ The project is located approximately ½ mile east of the intersection of 270th Street and NE 72nd Street, approximately 3 miles south of Nevada, Iowa. ▪ Latitude/Longitude: 41.9607°, -93.4515° (approximate)
Existing Improvements	None

Item	Description
Current Ground Cover	Agricultural field, grass, crop stubble
Existing Topography	Grades generally slope down from west to east across the site with about 40 feet of total elevation change (between approximate elevations 965 feet to 920 feet). An existing swale/drainageway, running northwest-southeast, is located immediately north of the proposed treatment plant.
Geology	The project site is located near the eastern boundary of a geomorphic region known as the "Des Moines Glacial Lobe". The Des Moines lobe deposits consist of relatively recent, poorly drained glacial material deposited during the Wisconsin glacial period. The glacial material consists of sandy clays, but silts and sand pockets are common, particularly near the surface. Subsurface materials can vary quickly over short distances, particularly near the end terminus of the lobe where the layering of deposits become jumbled. Glacial till soils also contain occasional zones of cobbles and boulders.

PROJECT DESCRIPTION

Our final understanding of the project conditions is as follows:

Item	Description
Project Description	HR Green is working with the City of Nevada to construct a new wastewater treatment facility that will include a variety of buildings and tank storage facilities.
Proposed Structure(s)	**Heavy Large Volume Tanks:** ■ (580) Biosolids Storage Tanks: two above grade 1.3 million gallon tanks, 100 feet diameter, water depth of 24 feet ■ (520) Aerobic Digestion Tanks: two below grade tanks, 68 feet x 68 feet, embedded 15 to 20 feet, water depth of 24 feet

Item	Description
Proposed Structure(s)	**Intermediate Tanks and Buildings:** ■ (210) Headworks Building: 36 feet by 58 feet concrete structure below grade with masonry superstructure, water depth 9 feet ■ (320) Oxidation Ditch Tanks: two above and below grade tanks, 100 feet by 160 feet, water depth of 15 feet ■ (350) Secondary Treatment Building: 30 feet by 48 feet concrete structure below grade with masonry superstructure ■ (380) Secondary Clarifier Tanks: three totally embedded tanks, 70 feet inside diameter, water depth of 14 feet ■ (550) Solids Processing Building: 40 feet by 68 feet concrete structure below grade with masonry superstructure ■ (420) UV Disinfection Building: 32 feet by 58 feet masonry structure with below grade concrete channels, wet-well water depth of 11 feet **Light Structures / Buildings:** ■ (120) Administration Building and Vehicle Storage Building: 50 feet by 134 feet metal building at grade, ■ (570) Bio-Solids Pump Building: 28 feet by 36 feet below grade concrete basement structure ■ (360) Chemical Storage Building: 14 feet by 29 feet at metal building ■ Engine Generator: 34½ feet by 42 feet at grade concrete structure

Item	Description
Approximate Existing Grade and Foundation Base Elevations **(provided by HR Green)**	**Heavy Large Volume Tanks:** ■ (520) Aerobic Digesters: existing grades = 950 to 956 feet; foundation base elevation = 930 feet ■ (580) Bio-Solids Storage Tanks: existing grade = 953 feet; foundation base elevation = 949 feet **Intermediate Tanks and Buildings:** ■ (210) Headworks Building: existing grade = 950 feet; foundation base elevation = 925 feet ■ (320) Oxidation Ditch Tanks: existing grades = 930 to 947 feet; foundation base elevation = 919 feet ■ (350) Secondary Treatment Building: existing grade = 922 feet; foundation base elevation = 906 feet ■ (380) Secondary Clarifier Tanks: existing grades = 915 to 922 feet; foundation base elevation = 904 feet ■ (420) UV Disinfection Building: existing grade = 915 feet; foundation base elevation = 903 feet ■ (550) Solids Processing Building: existing grade = 951 feet; foundation base elevation = 937 feet **Light Structures / Buildings:** ■ (120) Administration and Vehicle Storage Building: existing grade = 957 feet; foundation base elevation = 952 feet ■ (360) Chemical Storage Building: existing grade = 916 feet; foundation bearing elevation = 917 feet ■ (570) Bio-Solids Pump Building: existing grade = 953 feet; foundation base elevation = 935 feet ■ Engine Generator: foundation bearing elevation = 954 feet

Item	Description
Maximum Loads / Contact Pressures **(provided by HR Green)**	Heavy large volume tanks: ■ Contact pressures of about 1,500 psf based on a tank height of 24 feet ■ Foundation bearing pressures ≥ 2,000 psf Intermediate tanks: ■ Contact pressures of about 600 to 950 psf based on a tank height of 9 to 15 feet ■ Foundation bearing pressures ≥ 1,500 and < 2,000 psf Intermediate buildings: ■ Columns: 75 to 150 kips ■ Walls: 2 to 4 kips per linear foot ■ Suspended Floors: 100 psf ■ Floor Slabs-on-grade: 250 psf ■ Foundation bearing pressures ≥ 1,500 and < 2000 psf Light buildings: ■ Columns: 50 kips ■ Walls: 2 to 3 kips per linear foot ■ Suspended Floors: 100 psf ■ Floor Slabs-on-grade: 250 psf ■ Foundation bearing pressures < 1,500 psf
Approximate Grading/Excavations requirements	We expect fill placement in lower elevations, beneath portions of at grade structures constructed at or above existing grades, and adjacent to structures with below-grade walls. The following are the estimated cuts/excavation depths below existing grade required to develop the base elevation of tanks and the finished floor elevation of buildings: Heavy large volume tank excavation depths: ■ (520) Aerobic Digestion Tanks: 20 to 28 feet ■ (580) Bio-Solids Storage Tanks: 2 to 3 feet Intermediate tanks and buildings excavation depths: ■ (210) Headworks Building: 25 to 26 feet ■ (320) Oxidation Ditch Tanks: 10 to 27 feet ■ (350) Secondary Treatment Building: 11 to 17 feet ■ (380) Secondary Clarifier Tanks: 11 to 18 feet ■ (550) Solids Processing Building: 14 to 16 feet ■ (420) UV Disinfection Building: 12 to 13 feet Light buildings excavation depths: ■ (120) Administration and Vehicle Storage Building: 4 to 5 feet ■ (570) Bio-Solids Pump Building: 17 to 19 feet ■ (360) Chemical Storage Building: N/A, fill thickness < 2 feet

Item	Description
Free-Standing Retaining Walls	We understand that possible retaining walls less than 4 feet in height may be constructed to provide level areas for vehicle access.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical recommendations. Conditions encountered at each exploration point are indicated on the individual logs. The GeoModels, subsurface profiles and individual boring logs can be found in **Exploration Results**.

Stratification boundaries on the GeoModels, subsurface profiles, and boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. As noted in **General Comments**, the characterizations are based on widely spaced exploration points across the site, and variations are likely

As part of our analyses, we identified the following model layers within the subsurface profile. It should be recognized that not all borings encountered the same sequence of soil deposits. For a more detailed description of the model layer and layer depths at each boring location, refer to the GeoModels.

Model Layer	Layer Name	General Description
1	**Topsoils / Local Alluvium / Alluvium**	Approximately 6 to 12 inch Root Zone / Plow Zone Lean Clay, trace to with sand, trace organics (CL) Lean to Fat Clay, trace sand and organics (CL/CH)
2	**Wisconsinan Supraglacial Till**	Sandy Lean Clay/Clayey Sand, trace gravel (CL/SC) Sandy Lean Clay, trace gravel (CL) Occasional sand seams
3	**Glacial Outwash**	Fine to Coarse Grained Sand, trace gravel and varying amounts of silt and clay content (SP, SP/SM, SP/SC)
4	**Wisconsinan Subglacial Till**	Sandy Lean Clay, trace gravel (CL) Lean Clay, with sand to trace sand and gravel (CL) Occasional sand seams
5	**Loess**	Lean Clay, trace sand (CL)

Model Layer	Layer Name	General Description
6	**Pre-Illinoian Glacial Till**	Sandy Lean Clay, trace gravel (CL) Occasional sand seams and cobbles

Groundwater Conditions

The boreholes were observed while drilling, shortly after completion of drilling, and after periods of 3 to 7 days upon completion of drilling for the presence and level of groundwater. The detailed water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized in the following table.

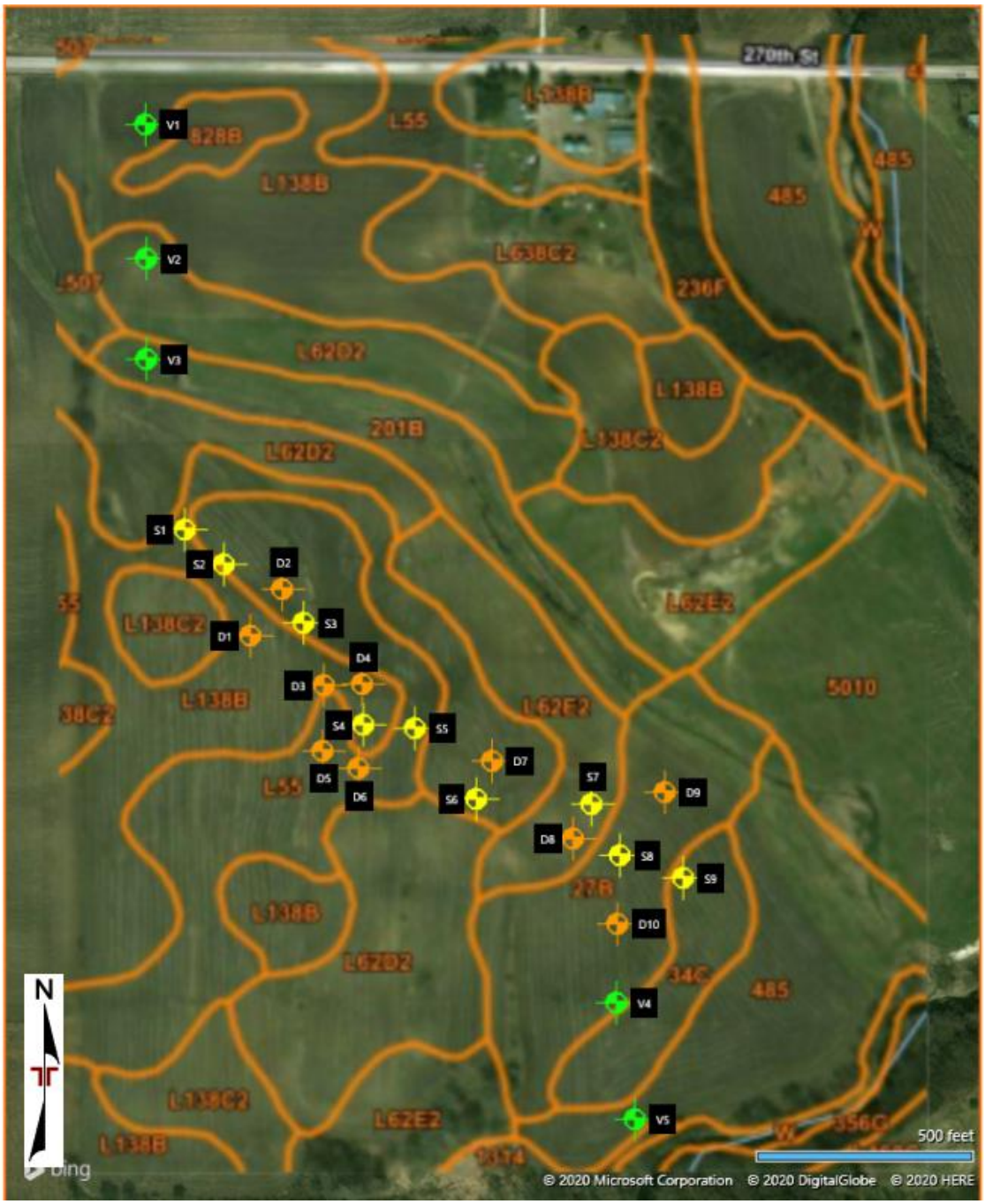
Structure	Nearby Borings	Approximate Depth bgs [1] (Elevations) of Groundwater, feet	
		During Drilling	3 to 7 Days After Drilling Completion [2]
(520) Aerobic Digestion Tanks	D1, D2	19 to 25 (elev. 932 to 933)	1 to 3 (elev. 950 to 955)
(580) Bio-Solids Tank - North (580) Bio-Solids Tank – South	D3, D4, D5, D6	6 to 34 (elev. 919 to 947)	1 to 3 (elev. 949 to 952½)
(320) Oxidation Ditch Tanks	D7, D8, S6, S7	12 to 49 (elev. 880 to 934)	½ to 9 (elev. 925 to 943)
(380) Sec. Clarifier Tank - North (380) Sec. Clarifier Tank - SW (380) Sec. Clarifier Tank - SE	D9 S8 S9	10 (elev. 913) 47 (elev. 873) 11 (elev. 904)	10 (elev. 913) 9 (elev. 911) 2½ (912½)
(350) Sec. Treatment Bldg	D9 S8	10 (elev. 913) 47 (elev. 873)	9 to 10 (elev. 911 to 913)
(360) Chem. Storage Bldg	D10, S9	10 to 11 (elev. 904 to 906)	1½ to 2½ (elev. 912½ to 914½)
(420) UV Disinfection Bldg	D10	10 (elev. 906)	1½ (elev. 914½)
(120) Administration and Vehicle Storage Bldg	S1 S2	11 (elev. 946) None Observed	3 (elev. 954) 3 (elev. 953)
(550) Solids Processing Bldg	D2 S3	19 (elev. 932) None observed	½ to 1 (elev. 950 to 952½)
(570) Bio-Solids Pump Bldg	S4	13 (elev. 940)	2 (elev. 951)
(210) Headworks Bldg	S5	20 (elev. 930)	1 (elev. 949)
Roadways and Utilities	V1 to V5	5 to 8 (elev. 900 to 948)	1 to 2 (elev. 903½ to 954)

1. bgs = Below ground surface
2. Delayed water levels as measured on April 13, 2020

The Natural Resource Conservation Service Web Soil Survey (WSS) indicates the primary near surface soil units at the sites are Clarion Loam, Nicollet Loam, Storden Loam, and Terril Loam with other soil units in portions of the site. The following table summarizes the properties and qualities of the major soil units that will likely be encountered near the ground surface, as mapped and described by the WSS.

Soil Unit Name (Parent Material)	Map Unit Symbol	Drainage Class	Approximate Depth [1] bgs to Seasonal High Water Table, feet
Estherville Sandy Loam (Glacial Till over Glacial Outwash)	34C	Somewhat excessively drained	> 6½
Zenor Sandy Loam (Glacial Outwash)	828B	Somewhat excessively drained	
Storden Loam (Glacial Till)	L62E2	Well drained	
Storden Loam (Glacial Till)	L62D2	Well drained	5 to 6
Clarion Loam (Glacial Till)	L138B	Well drained	4 to 5
27B Terril Loam (Colluvium)	27B	Well drained	3 to 4
Nicollet Loam (Glacial Till)	L55	Somewhat poorly drained	1 to 2
Spillville Loam (Alluvium)	485	Somewhat poorly drained	
Coland-Terril Complex (Alluvium)	201B	Poorly drained	0 to 1

1. bgs = Below natural ground surface



(Source: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be different than the levels indicated on the boring logs. The possibility of shallow groundwater and groundwater level

fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

Foundation Support

Due to the approximate 40 feet of grade difference across this site, proposed final grades, and structure bearing elevations, variable subsurface conditions should be expected beneath the proposed structures. In general, structures founded deeper in the subsurface profile could likely be founded on suitable, stiff to very stiff glacial till soils. Structures founded within the upper portion of the subsurface soil profile will likely encounter more variable support conditions. Lightly to moderately loaded structures utilizing relatively low bearing pressures could be founded within the upper profile whereas moderately to heavily loaded structures may require overexcavation and replacement with structural fill to provide improved bearing support. As an alternative to overexcavation and replacement procedures, rammed aggregate piers should be considered to provide improved bearing support while utilizing higher bearing pressures. We anticipate three general bearing conditions for structures will be encountered.

- **Bearing on suitable cohesive glacial till or granular glacial outwash soils or newly placed structural fill (if necessary):**

  We anticipate that suitable glacial till or glacial outwash soils will be encountered at planned foundation levels for the:
  - 120 Administrative and Vehicle Storage Buildings (Borings S1 and S2)
  - 520 Aerobic Digesters (Borings D1 and D2)
  - 550 Solids Processing Building (Boring S3)
  - 570 Bio-Solids Pump Building (Boring S4)
  - 210 Headworks Building (Boring S5)
  - 320 Oxidation Ditch Tanks (Borings D7, D8, S6 and S7)
  - 420 UV Disinfection Building (Boring D10)
  - Engine Generator

  We anticipate that foundations will likely bear on newly placed structural fill placed during initial grading operations for the:
  - 360 Chemical Storage Buildings (Borings S9 and D10)

Relatively conventional foundation design and construction considerations are considered appropriate at these facilities. Foundations bearing on suitable natural glacial till or glacial outwash or on newly placed structural fill can be designed for net allowable bearing pressures ranging between 1500 and 3000 pounds per square foot.

- **Bearing newly placed structural fill:**
  Relatively low strength soils were encountered at planned slab and/or foundation levels for the:
  - 580 Bio-Solids Storage Tanks (Borings D3, D4, D5 and D6)
  - 350 Secondary Treatment Building (Borings S8 and D9)
  - 380 Secondary Clarifier Tanks (Borings D9, S8 and S9)

  To provide more uniform support for slabs as well as spread foundations, we recommend undercutting soils below the base of foundation excavations to provide an adequate thickness of structural fill below foundations. For extensive, deep overexcavation and replacement procedures (e.g., under the proposed Bio-Solids Storage Tanks), either cohesive or granular structural fill may be used to support the proposed slabs and foundations. The selection of either cohesive and/or granular material beneath the Bio-solids Storage Tanks may depend upon how well groundwater levels are controlled in this area. Typically, clean, coarse granular material will be required where water is allowed to pond and soften the exposed subgrade.

  We would recommend that granular structural fill be utilized to provide improved foundation support for the proposed Secondary Treatment Building and Secondary Clarifier Tanks. Additionally, ground improvement (i.e., rammed aggregate piers, stone columns, etc.) could be considered as an alternative to overexcavation and replacement procedures. Rammed aggregate piers or stone columns could be utilized to increase allowable bearing pressures while possibly reducing settlements. More information about the ground improvement option can be found in **Shallow Foundation Support on Ground Improvement**.

More details on foundation support can be found in **Shallow Foundations**.

Groundwater and Subsurface Drainage

Based on the groundwater levels observed in the borings and the potential for water seepage, groundwater will likely be encountered in excavations during construction (e.g., broad excavation areas for below grade structures, excavations for utilities, foundations, etc.). Dewatering will be required where seepage is encountered and should be addressed in advance of construction. The contractor is responsible for employing appropriate dewatering methods to control seepage and facilitate construction.

Continuous influx of moisture seepage due to excavating below groundwater levels will make earthwork and preparation of the subgrades for floors and foundations more difficult. In relatively shallow excavations encountering predominantly cohesive soils, subsurface drainage methods might be able to consist of shallow ditches or trench drains (temporary or permanent) around the perimeter of the excavations to help intercept seepage. A series of sump pits and pumps might be adequate to remove accumulating water.

As discussed with the design team, consideration should be given to install interceptor drain lines around structures that will require deeper excavations well in advance of earthwork construction. The interceptor drain lines should be sloped to gravity drain and daylight to drainage areas. Based on our experience with similar soil profiles, we expect the majority of the moisture seepage will be encountered or perched within the upper Wisconsinan supraglacial till, above the Wisconsinan subglacial till soils. We envision that an interceptor drainage system installed and embedded a minimum of 1 foot into the Wisconsinan subglacial till will intercept the majority of the moisture seepage. More significant seepage could occur in deeper excavations where sand seams and sand layers are encountered, such as within the southeastern portion of this site within the vicinity of Borings D9, D10 and S8.

Boring information indicates granular glacial outwash is likely to be encountered at the base of excavations for the Secondary Treatment Building, UV Disinfection Building and the Secondary Clarifier Tanks. Where excavations terminate in sands or very sandy cohesive soils and cut off trench drains are not adequate to control collection and removal of water, then other dewatering systems, such as well points, will likely be needed to maintain water levels a minimum of 2 feet below the anticipated excavation depths. We recommend groundwater levels be lowered and maintained a minimum of 2 feet below the anticipated base of excavations encountering sand or very sandy soils to reduce the potential for buoyancy or “quick” sand boil conditions.

We recommend the installation of at least 8-inch thick crushed stone working mat (or thickness selected by the contractor) at the base of excavations to reduce potential for subgrade disturbances during construction. Installation of permanent drain lines within the structure footprint after excavation and placement of a working mat of crushed stone should be considered. The drain lines could serve as permanent drainage below the new structures along with a design thickness of granular drainage layer (see section **Below-Grade Structures**).

EARTHWORK

Excavation Considerations

Excavations up to about ±20 feet below existing grades are anticipated at this site. We expect that the majority of the excavations at this site will encounter predominately cohesive glacial till

soils with random sand seams and layers. Boring information within the southeast portion of this site, within the vicinity Borings S8, S9, D9 and D10, very sandy cohesive soils and/or thicker deposits of granular glacial outwash should be anticipated within the predominately cohesive glacial till deposits and these granular soils will be present near or immediately below the planned base of excavations. Unbraced excavations would possibly encroach upon adjacent structures or utilities. There is a risk that sloughing of sloped excavations will occur while the excavations remain open during construction, and a series of benches or flattened zones could be necessary to maintain stability. Excavation side slopes should be protected from erosion by diverting surface water away from the excavations.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stability and safe working conditions. Contractors, by their contract, are usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

To reduce the overall width required to complete excavations, and the associated zone of backfill, installation of earth retention systems (i.e., permanent or temporary shoring) would be needed. Design and installation of shoring systems should be provided by the contractor to allow for construction of the planned structures and should consider the impacts of groundwater.

Site Preparation

Site preparation should include stripping of all vegetation, organic soils, crop stubble, root systems, frozen soils, and other unsuitable materials from the site surface. Generally, site stripping depths are expected to range between 1 to 2 feet to adequately remove the plow zone and/or to remove soils containing organics from this existing agricultural field. Deeper stripping depths may be necessary in isolated areas or in topographically lower areas of the site where thicker vegetation, organic soils, or very soft soils may be present, such as near the existing waterway.

After any necessary stripping and performing any cuts or excavations to develop the planned subgrade levels for at-grade structures, the exposed subgrades should be evaluated to determine that suitable low plasticity (LL ≤ 45 and PI ≤ 23) material is present and extends to depths of at least 1½ feet below the base of grade-supported slabs. Boring information indicates that the majority of the near surface soils consist of low plasticity soils. However, where moderate to high plasticity soils (LL > 45 and PI > 23) are encountered immediately below grade-supported floor slabs, such as for the UV Disinfection Building, additional undercutting of the site soils will be needed to develop the recommended thickness of low plasticity soils below grade-supported floor

slabs. We recommend grade-supported slabs be constructed on a minimum of 1½ feet of low plasticity soils in order to reduce the potential for subgrade volume changes from causing distress to grade-supported slabs. Boring information indicates that moderate plasticity soils were encountered at the ground surface in Borings D10, V3, V4 and V5.

Lower-strength, high moisture content cohesive glacial till soils and/or loose granular glacial outwash soils are anticipated at the base of some excavations. If necessary, the structures' footprints in these areas should be undercut below the design aggregate base level below floor slabs in buildings and base elevations in tanks to provide at least 8 inches of crushed stone (or thickness selected by the Contractor) to help reduce subgrade disturbance and provide an all-weather working platform. Greater thicknesses of crushed stone may be required in some areas to achieve a stable subgrade, depending on the Contractor(s) intended use and type of equipment that will operate on the subgrade.

Following stripping operations and undercutting of low strength soils, and prior to placement of new fill, the at-grade structure areas should be proof-rolled with heavy, rubber tire construction equipment, to aid in delineating near surface areas of low density, soft, or otherwise unsuitable soil that may require additional removal prior to construction. Proofrolling should be accomplished using a fully loaded, tandem axle dump truck or other equipment providing an equivalent subgrade loading (minimum gross weight of 25 tons is recommended for the proofrolling equipment). Unstable areas identified by proofrolling should be undercut to expose stable material and backfilled with low plasticity structural fill. Proofrolling of subgrades in below grade structure areas is not necessary; however, the exposed soils at the base of excavations should be evaluated during excavation and during the recommended compaction process. Unsuitable areas observed at these times should be corrected prior to construction.

Terracon should be retained to develop a thorough observation and testing program. The testing should be performed prior to and during construction.

Subgrade Stabilization

Subgrades disturbed by precipitation and construction activity or found to be unsuitable during surficial compaction or proofrolling should be improved before new fill or the aggregate base and ground-supported slabs are placed. Terracon should be retained to discuss stabilization options. Potential methods of subgrade improvement are described below. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs.

- **Scarification and Compaction** – Soils can be scarified, moisture conditioned (i.e., dried or wetted), and compacted. The success of this procedure depends primarily on favorable weather and sufficient time to manipulate the soils. Even with adequate time and favorable weather, stable subgrades may not be achieved if the thickness of the unstable material is greater than about 1 to 1½ feet.

- **Undercut and Replacement with Crushed Stone/Aggregate** – The use of crushed stone, crushed concrete, and/or gravel could be considered to improve subgrade stability. To limit depths of undercuts, the use of a geosynthetic (i.e., a geogrid or a high-modulus geotextile) could be considered after underground work, such as utility construction, is completed. Equipment should not be operated above the geosynthetic until one full lift of crushed stoned/aggregate is placed above it. The maximum particle size of material placed over a geosynthetic generally should not exceed 1½ inches. Gradation requirements for backfill materials provided by the geosynthetic product manufacturer should be verified prior to material purchase and delivery to the site.

- **Chemical Treatment** – Chemical modification or stabilization of high water content soils can be accomplished with hydrated lime, Class C fly ash or portland cement. Chemical treatment should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades on similar sized projects with similar soil conditions. The use of chemical agents can impact the operation of adjacent facilities (e.g., wind-blown dust), and this should be considered by the designer and contractor. Terracon should be notified prior to selection of a chemical stabilization agent to allow time for a review the material's source and chemical constituents data sheet. For estimating purposes, the incorporation rate for portland cement is typically 4 to 6 percent (on a dry soil unit rate basis), whereas Class C fly ash is typically 12 to 15 percent (on a dry soil unit rate basis).

Structural Fill Material Types

We anticipate the majority of earthwork grading operations will include utilizing the near surface inorganic portions of the topsoil, the near surface cohesive glacial supraglacial till, and deeper subglacial till deposits which will likely consist of lean clay and sandy lean clay soils.

Structural fill should meet the following material property requirements.

Soil Type [1]	USCS Classification	Acceptable Location for Placement
On-site cohesive soils [2, 3]	Lean clay (CL), sandy lean clay (CL), or lean to fat clay (CL/CH)	n Site soils with LL ≤ 45 and PI ≤ 23 could be used below aggregate base for grade-supported slabs n Site soils with LL > 45 and PI > 23 could be used more than 1½ feet below grade-supported slabs n Outside granular drainage zones adjacent to below-grade walls [4]
Imported low plasticity cohesive soils [3]	CL Non-organic with LL ≤ 45 and PI ≤ 23 [2]	n Below aggregate base for grade-supported slabs n Below foundations and the aggregate base below-grade floor slabs in overexcavations n Outside granular drainage zones adjacent to below-grade walls [4]
Imported granular material [5]	GW, GP, GM, GC SW, SP, SM, SC	n Below aggregate base for grade-supported slabs n Below foundations and below aggregate base below-grade floor slabs in overexcavations n Backfill adjacent to below-grade walls [4]
Unsuitable soils	ML, OL, OH, PT	n Non-structural locations n Importing moderate to high plasticity (MH and CH) cohesive soil is not recommended

1. Structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this site.
2. Structural fill within 1½ feet of the floor slabs in the building/structure areas should consist of low plasticity materials. By our definition, low plasticity materials should have a liquid limit of 45 or less and a plasticity index of 23 or less (ASTM D 4318).
3. Fine grained material (e.g., clays) can be difficult to compact in relatively small areas (e.g., excavations for foundations or utilities). Moisture conditioning (e.g., drying) would be necessary to achieve compaction requirements if fine grained material is used as structural fill for this project.
4. Recommendations for backfill material for walls constructed to retain soils, such as cast-in-place concrete walls and retaining walls, are included in section **Lateral Earth Pressures**.
5. Specific material requirements will need to be satisfied based on the intended use.

Structural Fill Compaction Requirements

As previously mentioned, extensive grading operations and excavations up to 20 feet are expected at this site to provide the desired final grades or structure foundation grades. We anticipate the majority of earthwork operations will consist of excavating and reusing the cohesive Wisconsinan glacial till soils. Boring information suggests that the near surface, cohesive supraglacial till soils, granular glacial outwash, and the cohesive alluvium, encountered in the lower areas of this site, were generally slightly above to well above the recommended water content range for compaction. The deeper cohesive subglacial till soils were generally near to slightly above the recommended water content range for compaction. Cohesive or granular soils to be excavated and reused as general grading fill in other areas of this site, including as structural

fill beneath structures, will likely require adjustment of the soils' water content in order to lower or raise the moisture to within the recommended water content range.

Structural fill should meet the following compaction requirements.

Item	Description
Fill lift thickness	n 9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used n 4 inches in loose thickness when hand equipment (e.g., jumping jack, vibratory plate compactor, etc.) is used
Compaction of cohesive soil [1, 2]	n At least 95% n At least 98% beneath foundations
Compaction of granular material [1, 2, 3]	n At least 98%
Moisture content of cohesive soil [1]	n Within the range of 0% to +4% of the optimum water content at the time of placement and compaction.
Moisture content of granular material [4]	n Workable moisture levels

1. Compaction values and moisture contents are relative to the materials' standard Proctor maximum dry unit weight and optimum water content (ASTM D698).
2. We recommend structural fill be tested for compaction and moisture content during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
3. If the granular material is a coarse sand or gravel, is of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).
4. Specifically, the moisture content of the granular material should be at a level to achieve compaction without the granular material bulking during placement or pumping when proofrolled.

Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction, including backfill placement and compaction. If utility trenches are backfilled with relatively clean coarse-grained material, they should be capped with at least 18 inches of low permeability cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill.

Utility trenches are a common source of water infiltration and migration. Utility trenches constructed in cohesive soils that penetrate beneath structures or equipment that are sensitive to moisture should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the structure. We recommend constructing an effective clay "trench plug" of either low permeability clay soil or flowable fill that extends a sufficient distance from the face of the structure. If clay soils are used for the plug, the material should be compacted at or above the soil's optimum water content. The clay soil or flowable fill should be placed to completely surround

the utility line and any granular envelope and be compacted or placed in accordance with recommendations in this report. Care should be taken as to not damage the in-place utility.

We understand that some site utilities may not be embedded to frost depth. The natural cohesive soils encountered at this site are frost susceptible. Utilities not supported at or below frost depth and exposed to freezing temperatures can be subjected to frost heave movements. We recommend that utilities not embedded below frost depth be constructed to bear on 2 or more feet of low-frost susceptible granular material. We recommend the low-frost susceptible material consist of a well graded, clean granular material with less than 6% passing the No. 200 sieve. As an alternative to extending the low-frost susceptible granular fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of low-frost susceptible fill.

Vehicular traffic over shallow utilities may result in distress or damage to the utilities. Considerations could be given to placing geogrid and rock over the top of the shallow utilities to spread out vehicular loads and help protect the utilities. As an alternative and depending upon vehicular loads and repetition, a concrete slab could be constructed over the top of shallow utilities to provide further protection.

Grading and Drainage

Adequate drainage should be provided on the site during construction and final grades should slope away from structures in order to divert surface water. Excessive moisture can significantly reduce the support capability of cohesive soils and contribute to soft subgrades and difficult earthwork operations. During earthwork operations, exposed subgrades should be properly sloped to provide rapid drainage so that risks of saturation of the subgrades can be reduced. The soil types observed in the borings are easily eroded by surface water, so appropriate erosion control measures should be provided.

All surface water that accumulates on subgrades should be removed as soon as possible. Excavations for foundations might extend beneath the typical groundwater levels and/or encounter perched water in the upper soil strata during and following wet seasons. Groundwater which collects in excavations should be removed as soon as possible. Removal of groundwater from excavations encountering cohesive soils can usually be accomplished by using a sump pit and pump system. More extensive dewatering systems will be required where excavations extend below seasonal groundwater levels or where sand seams are encountered. The contractor is responsible for employing appropriate dewatering methods to control seepage and facilitate construction.

Positive drainage away from the structures should be incorporated into the design plans. Ponding of water adjacent to the structure foundations could contribute to moisture increases in the subgrade soils and subsequent loss of strength and/or possible settlement.

Earthwork Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Should unstable subgrade conditions develop, stabilization measures will need to be employed. Terracon should be contacted to discuss alternatives to stabilize subgrades.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stability and safe working conditions (if applicable). Temporary excavations will likely be required during grading operations and installation of utilities. Contractors, by their contract, are usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the grade-supported slabs. Moderate to high plasticity soils should not be allowed to dry out prior to construction. Construction traffic over the completed subgrade should be avoided to the extent practical. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to grade-supported slab construction.

By conducting this exploration and site characterization, Terracon is in an advantageous and beneficial position to observe and evaluate conditions exposed during construction and compare to the findings of the exploration, which would assist in resolutions if variations are present. Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of grade-supported slabs.

Construction Observation and Testing

The earthwork efforts should be observed and tested by a representative of the Geotechnical Engineer. Observation and testing should include documentation of adequate removal of

vegetation and topsoil, proofrolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the substation area. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by a representative of the Geotechnical Engineer. In the event unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to discuss mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Spread Footing Foundation Design Recommendations

Item	Bearing on Suitable Natural Soils or on Structural Fill [1]	Low Strength and/or Variable Bearing Conditions [2, 3]
Required bearing materials [4]	n Medium stiff to stiff, cohesive glacial till or medium dense, granular glacial outwash soils [7, 8] n Stiff to very stiff cohesive glacial till or medium dense to dense granular glacial outwash [9, 12] n Adequate thickness of structural fill, as required, extending to suitable natural soils [10, 11, 13]	n A minimum of 2 feet or more of granular structural fill [10] n A minimum of 3 feet or more of granular structural fill [11] n Foundations bearing on 5 or more feet of cohesive or granular structural fill [13]
Maximum net allowable bearing pressure [4, 5]	n 1,500 psf [7] n 2,000 psf [8] n 2,500 psf [9] n 3,000 psf [12]	n 2,500 psf [10] n 2,500 psf [12] n 3,000 psf [13]
Estimated total settlement [6, 7]	n 1 inch or less	n 1 inch or less

General Foundation Design Recommendations	
Estimated settlement [14]	n 1 inch or less total settlements n About ⅔ of total settlement
Minimum foundation dimensions	n Column footings: 30 inches n Continuous footings: 18 inches
Minimum embedment below finished grade [15]	n Exterior footings: 42 inches n Interior footings in heated areas: 16 inches
Ultimate passive pressure [16] (equivalent fluid density)	See the **Lateral Earth Pressures** in **Below-Grade Structures** section
Ultimate coefficient of sliding friction [17]	

1. Conditions present in borings near Administrative and Vehicular Storage Buildings, Chemical Storage Building, UV Disinfection Building, Bio-Solids Pump Building, Oxidation Ditch Tanks, Aerobic Digesters, Solids Processing Building and Headworks Building. We anticipate the Engine Generator will be constructed near existing grades and will be founded on medium stiff to stiff natural glacial till soils.

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2. Conditions present in borings near Secondary Treatment Building, Secondary Clarifier Tanks, Bio-Solids Storage Tanks. Also see **Shallow Foundation Support on Ground Improvement** for other considerations.
3. Unsuitable or low strength soils should be undercut and replaced according to the recommendations presented in the **Spread Footing Foundation Construction Considerations** section.
4. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.
5. Values provided are for maximum loads noted in the **Project Description** section.
6. Foundation settlement will depend on the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of structural fill, and the quality of the earthwork operations.
7. Administration and Vehicular Storage Building, Chemical Storage Building, UV Disinfection Building, Engine Generator
8. Bio-Solids Pump Building
9. Oxidation Ditch Tanks
10. Secondary Treatment Building
11. Secondary Clarifier Tanks
12. Aerobic Digesters, Solids Processing Building, Headworks Building
13. Bio-Solids Storage Tanks
14. Frequent control joints in the structure and sufficiently flexible connections are recommended help to accommodate differential settlement across the length of the building.
15. Embedment necessary to minimize the effects of frost and/or seasonal water content variations.
16. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. The portion of the passive resistance pressure distribution in the upper 3½ feet of the soil profile in exterior locations should be neglected due to frost effects. We also recommend that the upper 1½ feet of the passive pressure distribution be neglected for footings within climate controlled interior locations. Some horizontal movement of the foundation must occur to mobilize passive resistance.
17. Sliding friction along the base of the footings will not develop where net uplift conditions exist

Spread Footing Foundation Construction Considerations

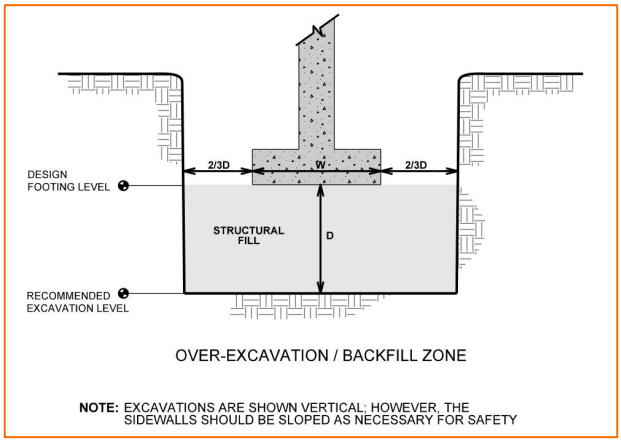
As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The use of earth formed “trench” footings generally appears feasible in the on-site cohesive soils, However, forming of footings would be required in areas where low strength soils are removed and replaced with overexcavation and backfill procedures, or where foundation excavations extend beneath granular working surface layers.

Where lower strength native cohesive soils exhibiting unconfined compressive strengths less than the recommended net allowable soil bearing pressure (determined by field tests such as hand penetrometer, static cone penetrometer, vane shear, etc.) are encountered within 2 feet below

the structure's foundation bearing elevation, overexcavations should extend to the greatest of the following depths in order to develop recommended thicknesses of structural fill below spread footing foundations:

- 50% of the width of isolated foundations,
- 100% of the width of continuous foundations, or
- 2 feet

The overexcavations for compacted structural fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with well-graded granular material (e.g., approved granular materials containing less than 10% passing the No. 200 sieve) placed and compacted as recommended in the **Earthwork** section of this report. The overexcavation and backfill procedure is illustrated in the adjacent figure. Lean concrete could also be used to backfill the overexcavations and widening of the exactions as described above would be required, unless suitable strength soils are encountered at the base of the deepened excavations.



The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed. If foundation excavations will need to be left exposed for extended periods, we suggest that the initial excavations be deepened slightly, and a concrete mud mat or layer of compacted crushed stone be placed as a working surface to reduce potential weakening and disturbance.

SHALLOW FOUNDATION SUPPORT ON GROUND IMPROVEMENT

A proprietary ground improvement system (e.g., rammed aggregate piers, stone columns, etc.) could be considered to reinforce or strengthen lower strength soils encountered at some of the structure locations to improve or provide more uniformity for support of spread footing foundations. These ground improvement systems improve the support capability of the site soils and reduce the potential for excessive total and differential settlement of shallow foundations supported above the reinforced soil subgrade.

Structure sites that are anticipated to encounter relatively lower strength foundation soils include:

- Secondary Treatment Building
- Secondary Clarifier Tanks
- Bio-Solids Storage Tanks

The ground improvement systems consist of densified aggregate piers or columns (typically 18 to 30-inch diameter). When properly designed and installed, these systems can develop relatively higher allowable bearing pressures for spread footing foundations while maintaining structure settlements within tolerable magnitudes. The contribution of settlement of deeper soils that are not reinforced by these methods needs to be considered.

Ground improvement systems are proprietary designs and are designed and installed by a specialty contractor. Due to the specialty of these soil improvement procedures, we recommend that a performance specification be used (i.e., designate a desired range of foundation bearing pressure and tolerable settlement). We would be pleased to provide additional information and references regarding these ground improvement alternatives, upon request.

The spread footing foundations supported above ground improvement systems can then be designed and constructed by conventional means. General foundation design parameters are provided in the following table.

Description	Value
Bearing conditions, and Net allowable bearing pressure [1]	n Proprietary ground improvement system n Allowable bearing pressure: determined by proprietary designer (estimated to be in range of 4,000 to 6,000 psf)
Minimum footing widths	n Continuous footings: 18 inches n Column footings: 30 inches
Minimum embedment below finished grade for frost protection [2]	3½ feet
Estimated total settlement [3]	Typically 1 inch or less (to be determined by proprietary designer)
Estimated differential settlement [3, 4]	Typically ⅔ to ¾ of the total settlement (to be determined by proprietary designer)
Ultimate passive pressure [5] **(equivalent fluid density)**	See the **Lateral Earth Pressures** in **Below-Grade Structures** section
Ultimate coefficient of sliding friction [6]	

Description	Value
Continued from Page 24	
1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. The allowable bearing pressure used for design of the foundations could be increased by 1/3 for use with the alternative load combination given in Section 1605.3.2 of the IBC if confirmed by proprietary designer. 2. Minimum embedment may also reduce the effects of seasonal moisture variations in the subgrade soils. Minimum embedment applies to perimeter footings and footings beneath unheated areas. Where interior footings will not be subject to freezing weather and large moisture fluctuations during or after construction, the minimum embedment below top of slab could be reduced to 1½ feet. 3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of structural fill, and the quality of the earthwork operations. 4. Frequent control joints in the structure and sufficiently flexible connections are recommended help to accommodate differential settlement. 5. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. The portion of the passive resistance pressure distribution in the upper 3½ feet of the soil profile in exterior locations should be neglected due to frost effects. We also recommend that the upper 1½ feet of the passive pressure distribution be neglected for footings within climate controlled interior locations. Some horizontal movement of the foundation must occur to mobilize passive resistance. 6. Sliding friction along the base of the footings will not develop where net uplift conditions exist.	

Forming of footings may be required above the ground improvement elements. It is customary or recommended by designers that after excavations are made back to the tops of the elements in the footprint of the foundation, that the aggregate top of the elements be densified with compaction equipment.

The base of all foundation excavations should be free of water, and loose soil prior to placing concrete. Concrete should be placed soon after excavating and the compaction procedure to reduce further disturbance of the bearing surface. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

SEISMIC CONSIDERATIONS

The Site Class is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Subsurface explorations at this site were extended to a maximum depth of about 50½ feet. The site properties

below the boring depths to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.

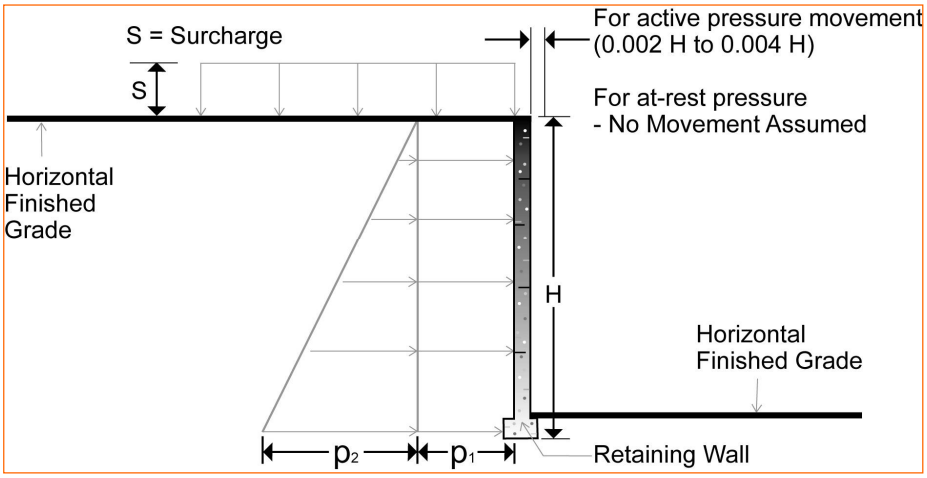
Based on the general soil/bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the Seismic Site Class is D. However, an improved seismic site classification might be possible for some of the site structures based on the relative depth of bedrock materials to the planned base elevations. Additional geophysical testing may be performed to confirm the seismic parameter conditions below the current boring depths and provide higher seismic site classification, if it would have a significant effect on structural design measures.

BELOW-GRADE STRUCTURES

Lateral Earth Pressure Design Recommendations

Reinforced concrete walls for the below grade tank structures, or any walls designed to retain soil, with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, final grades or sloping of ground adjacent to the walls, surcharges, methods of construction and/or compaction and the strength of the materials being restrained. The recommended design lateral earth pressures provided in this section are for cast-in-place, reinforced concrete walls only, and are not applicable to other wall systems (e.g., segmental block, landscaping walls, etc.).

Two wall restraint conditions are provided in the following table. The "at-rest" condition is commonly used for design of below grade dock walls and other walls restrained from movement and assumes no wall movement. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The surcharge component applies where floor loads or other loading will be applied adjacent to the below grade walls. The recommended design lateral earth pressures do not include a factor of safety.



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	**Coefficient for Backfill Type** [2]	**Surcharge Pressure** [2, 3, 4] **(psf)**	**Effective Fluid Pressures** [2, 4, 5, 6] **(psf)**	
			Drained	**Undrained**
At-Rest (K_o)	Granular: 0.50 Cohesive: 0.59	(0.50)S (0.59)S	(60)H (70)H	(90)H (95)H
Active (K_a)	Coarse-grained: 0.33 Fine-grained: 0.42	(0.33)S (0.42)S	(40)H (50)H	(80)H (85)H
Passive [7] (K_p)	Granular: 3.0 Cohesive: 2.4	--- ---	(360)D (285)D	(235)D (200)D
Sliding Resistance [8]	Ultimate coefficient of sliding friction for suitable bearing soils: 0.4			

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance
2. Considers horizontal ground surfaces at the top and base of walls. Sloping ground surfaces would require adjustments in these factors and corresponding lateral earth pressures.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values. H value is used for active and at-rest pressure computations from the top of wall. D value (not shown on figure) is used for passive pressure computations and is depth of foundation embedment below lowest grade at base of wall.
6. In order to achieve "Drained" conditions, follow guidelines in the **Below Grade Walls Subsurface Drainage** section. "Undrained" conditions are recommended when drainage behind walls is not incorporated into the design or where walls will be submerged during flooding events.
7. Passive pressure resistance distribution should consider frost effects as discussed in the **Shallow Foundations** section.
8. Sliding friction along the base of the footings will not develop where net uplift conditions exist

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the at-rest/active and passive cases, respectively.

Below-Grade Slab Design Parameters

Item	Description
Below-grade slab support	n Prepared according to the **Earthwork** section.
Aggregate base	n At least 8 inches of free-draining granular material [1] n This drainage layer would be in addition to any working mat thickness incorporated in the construction.
Estimated modulus of subgrade reaction [2]	n k_1 = 150 psi/in

1. Free-draining granular material such as IaDOT 4131 porous backfill.
2. Modulus of subgrade reaction value is provided for point loads. For large area loads the modulus of subgrade reaction would be lower. This value is representative of a 1 foot by 1 foot loaded area supported on recommended thickness of granular materials and should be scaled appropriately as the loaded area increases. See **Floor Slab Design Parameters** in **Floor Slabs** for additional notes.

A system of collector drains should be constructed at the base of the free-draining granular layer. A relatively basic floor drainage system could consist of interior drain lines located around the perimeter of the below grade walls and at about 30 feet on-center. The drain lines should be placed in shallow trenches that extend below the base of the granular layer under the grade-supported slab. General recommendations for the drain system are provided below.

Item	Description
Subdrain pipe	Minimum 4-inch pipe diameter
Subdrain lines	n Pipe invert should be at least 12 inches below the slabs in continuously heated areas, and at least 42 inches below the slabs if potentially exposed to seasonal freezing climate n Subdrain lines should be sloped to provide positive gravity drainage to a reliable discharge point or sump pit n Subdrain lines should be embedded in at least 4 inches of subdrain trench backfill material
Subdrain trench backfill [1]	n IaDOT porous backfill (Section 4131) [2], or n Free-draining granular material encapsulated with non-woven geotextile filter fabric

Item	Description
Continued from Page 28	
	1. The subdrain trench backfill should extend up to and be hydraulically connected to the recommended aggregate base layer below the floor slabs. 2. Pipe perforations should be appropriately sized to prevent free-draining granular material from entering the subdrain pipe.

As previously discussed, the possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. If groundwater levels rise above the bottom of a structure when it is empty, uplift loads could be imposed on the bottom slab and hydrostatic pressure could be imposed on the walls, which could cause heaving, cracking or other damage to the bottom slab and walls. We anticipate the designs will include measures to reduce hydrostatic loading for the below grade tanks, such as pressure relief valves that will allow backflow of groundwater into empty structures or exterior pumping systems.

Additional design recommendations and commentary for grade supported slabs are included in **Floor Slabs**.

Below Grade Walls Subsurface Drainage

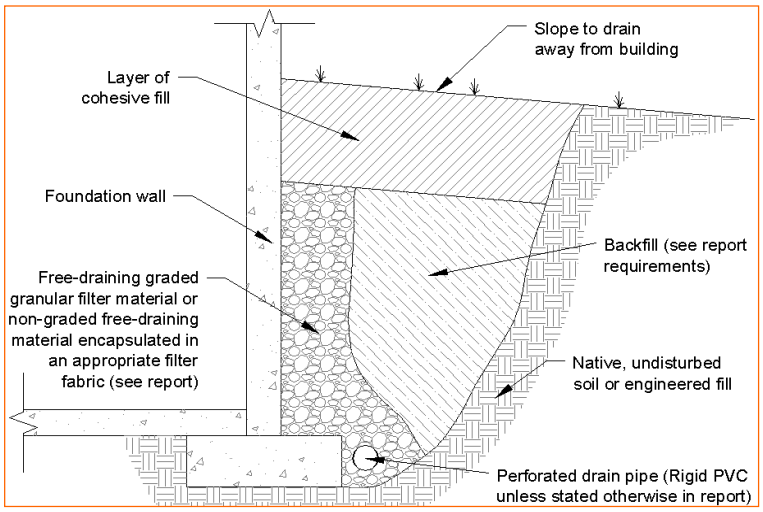
To reduce hydrostatic loading on the below grade walls, we recommend a drainage system be installed along the walls and extend to the foundation of the below grade walls. The wall drain system should be designed according to the following table and accompanying sketch. The drainage systems for below grade floors should be considered with the design of drainage systems for below grade walls.

Item	Description
Below grade wall subdrain pipe	n Perforated rigid plastic drain line with a minimum 4-inch diameter. n Pipe perforations should be appropriately sized to prevent free-draining granular material from entering the subdrain pipe. n Pipe invert should be at least 3½ feet below proposed exterior grade or at the foundation of the wall, whichever is deepest. n Subdrain lines should be sloped to provide positive gravity drainage to daylight or to a reliable discharge point (e.g., storm sewer, sump pit and pump, etc.). n Pipes should be embedded in at least 4 inches of wall drainage backfill material.

Continued on Page 30

Item	Description
Continued from Page 29	
Wall drainage backfill [1]	n A minimum 2-ft wide section of coarse-grained (granular) fill located above the drain line and adjacent to the walls, consisting of either: o IaDOT porous backfill (Section 4131), or o Free-draining coarse-grained material encapsulated with non-woven geotextile filter fabric (Contech C60NW or equivalent). n The coarse-grained fill should extend to within 2 feet of final grade, where it should be capped with fine-grained structural fill to reduce infiltration of surface water into the subdrain system.

1. As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.



If walls must resist combined hydrostatic and lateral earth pressures, then combined hydrostatic and lateral earth pressures should be calculated using the "undrained" values in **Lateral Earth Pressure Design Recommendations**. Water stops and other wall waterproofing measures should also be considered if undrained designs are used.

FLOOR SLABS

Design parameters for at-grade floor slabs expect the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structures and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor slab support for at grade structures [1]	n Minimum 6 inches of free-draining granular material [2] n At least 18 inches of low plasticity materials should be present below floor slabs (the 6-inch free-draining granular layer is considered to be part of the recommended 18-inch low plasticity material zone)
Estimated modulus of subgrade reaction [3]	n k_1 = 150 psi/in

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Free-draining granular material should have less than 6 percent fines (material passing the #200 sieve), e.g., IaDOT granular subbase (Section 4121). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions
3. Modulus of subgrade reaction is an estimated value based on our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower. This value is representative of a 1 foot by 1 foot loaded area supported on recommended thickness of granular materials and should be scaled appropriately as the loaded area increases. The coefficient decreases as the width of the loaded area increases. The following equation by Das (2011) or other appropriate relations can be used to scale the coefficient of subgrade reaction:

   $k = k_1 [(B+1) / (2B)]^2$

   where k_1 = coefficient of subgrade reaction (1 foot by 1 foot area)
   k = scaled coefficient of subgrade reaction
   B = width of loaded area

   (Das, B.M., 2011, Principles of Foundation Engineering, 7th Edition, Pacific Grove, California, Brooks/Cole Publishing Company, p. 311)

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential vertical movement through use of sufficient control joints, appropriate reinforcing or other means.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Exterior Slabs and Frost Considerations

The soils on this site are frost susceptible, and water migration into soils can affect the performance of slabs, including doorways, and pavements exposed to climatic and temperature variations. Exterior slabs should be anticipated to heave during winter months. If frost action

needs to be eliminated in critical areas, we recommend the use of low-frost susceptible fill or structural slabs (e.g., structural stoops in front of building doors). The following recommendations could also be considered to help reduce potential frost heave:

- Providing surface drainage away from the buildings and slabs and toward the site storm drainage system;
- Placing low-frost susceptible fill as backfill below structures to frost protection depth (at least 3½ feet below final exterior grade in non-heated areas);
- Installing drain tiles at or below the frost depth around the perimeter of the grade-supported structures that is hydraulically connected to the granular drainage layer and discharges directly to a reliable outlet, i.e., storm drainage system;
- Grading clayey subgrades such that groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base layers, slope toward the site drainage system

The drain lines referenced above should be sloped for positive gravity discharge to a storm sewer or another reliable discharge point, and reverse flow into the system should be prevented. Periodic maintenance of subdrains is required for long-term proper performance.

Low-frost susceptible materials should consist of a well-graded, clean granular material with less than 6% passing the No. 200 sieve.

As an alternative to extending the low-frost susceptible fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of low-frost susceptible fill.

Floor Slab Construction Considerations

Grading for floor slab subgrades is typically accomplished relatively early in the construction phase. Fills are placed and compacted and the initial surface is prepared in a relatively uniform manner. However, as construction proceeds, utility excavations, rainfall, and heavy construction traffic can disturb the subgrade. Surface irregularities are often filled with loose materials to temporarily improve trafficability. As a result, the floor slab subgrade, prepared earlier during initial site grading operations should be carefully evaluated as the time for slab construction approaches. Particular attention should be given to high traffic areas that become rutted and disturbed, and to areas where backfilled trenches are located.

Areas where unstable conditions exist should be repaired by removing and replacing the materials with low plasticity structural fill. All floor slab subgrade areas should be moisture conditioned and compacted to the recommendations in **Earthwork** immediately prior to placement of the aggregate base materials and concrete.

Care will be necessary to avoid contaminating the aggregate base layer located directly below the floor slabs with soil prior to floor slab placement. We recommend the aggregate base layer be placed only immediately prior to slab concrete placement.

GENERAL COMMENTS

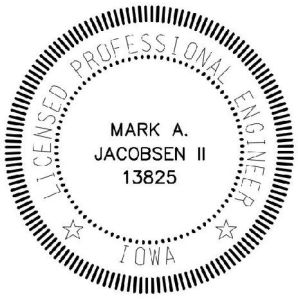
Our analysis and opinions are based on our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon should be retained to provide observation and testing services during grading, excavation, foundation construction, and other earth-related construction phases of the project. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance on the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location

of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. _____ May 22, 2020 Mark A. Jacobsen II, P.E. Date My license renewal date is December 31, 2020.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Location	Borings Nos. [1]	Boring Depths, feet (bgs) [2]
(520) Aerobic Digestion Tanks	D1, D2	50½
(580) Bio-Solids Storage Tanks	D3, D4, D5, D6	50½
(320) Oxidation Ditch Tanks	D7, D8 S6, S7	50½ 30½ and 40½
(380) Secondary Clarifier Tanks	D9 S8, S9	50½ 30½ and 35½
(420) UV Disinfection Building	D10	50½
(120) Administration and Vehicle Storage Building	S1, S2	30½
(550) Solids Processing Building	S3	35½
(570) Bio-Solids Pump Building	S4	35½
(210) Headworks Building	S5	40½
Roadways and Utilities	V1, V2, V3, V4, V5	15½

1. See Exhibit E for the Anticipated Exploration Plan.
2. bgs = below existing ground surface.

Boring Layout and Elevations: Terracon personnel staked the boring locations using handheld GPS equipment with respect to provided boring coordinates. Following drilling operations, HRG provided boring coordinates and ground surface elevations. The boring locations are shown on the **Exploration Plan**. The boring coordinates and elevations are indicated on the boring logs.

Subsurface Exploration Procedures: We advanced the soil borings with an ATV-mounted drill rig using hollow-stem and solid-stem continuous flight augers. Five to six samples were obtained in the upper 15 feet of the borings and samples were obtained at intervals of 5 feet thereafter. Several borings included additional sampling beneath the floor slab/foundation elevations. Soil sampling was performed using thin-wall tube and split-barrel sampling procedures. We observed and recorded groundwater levels during drilling, immediately after drilling and after periods of 3 to 7 days after drilling operations. The borings were backfilled with a mixture of bentonite chips and auger cuttings upon boring completion.

The drill crew prepared a field log of each boring to record field data including visual descriptions of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation

of the subsurface conditions at each boring location based on field and laboratory data, and observation of the samples.

Laboratory Testing

In the laboratory, water content tests were performed on portions of the recovered samples. The dry unit weight of intact, thin-walled tube samples was determined. Unconfined compressive strength and hand penetrometer tests were performed to estimate the consistency of select samples of fine-grained soils. In order to better define the plasticity of the soils encountered at this site, Grain Size Analyses and Atterberg limits tests were performed on samples of fine-grained soils that are likely to be encountered either during earthwork operations or foundation construction. The results of the laboratory tests are shown on the boring logs at their corresponding sample depths and as graphs in **Exploration Results**.

Boring Nos.	Approximate Sample Depth(s) feet (bgs) [1]	Stratum	Atterberg Limits		
			Liquid Limit	Plastic Limit	Plasticity Index
D6	9 to 11	2	27	15	12
D7	34 to 35½	4	31	15	16
V4	3 to 5	1	33	20	13

1. bgs = below existing ground surface

The samples were described in the laboratory based on visual observation, texture and plasticity, and the laboratory testing described above. The descriptions of the soils indicated on the boring logs are in general accordance with the General Notes and Unified Soil Classification System (USCS) summarized and included in **Supporting Information**.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location
Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Nevada Wastewater Treatment Facility ■ Nevada, Iowa
May 22, 2020 ■ Terracon Project No. 08205065-01

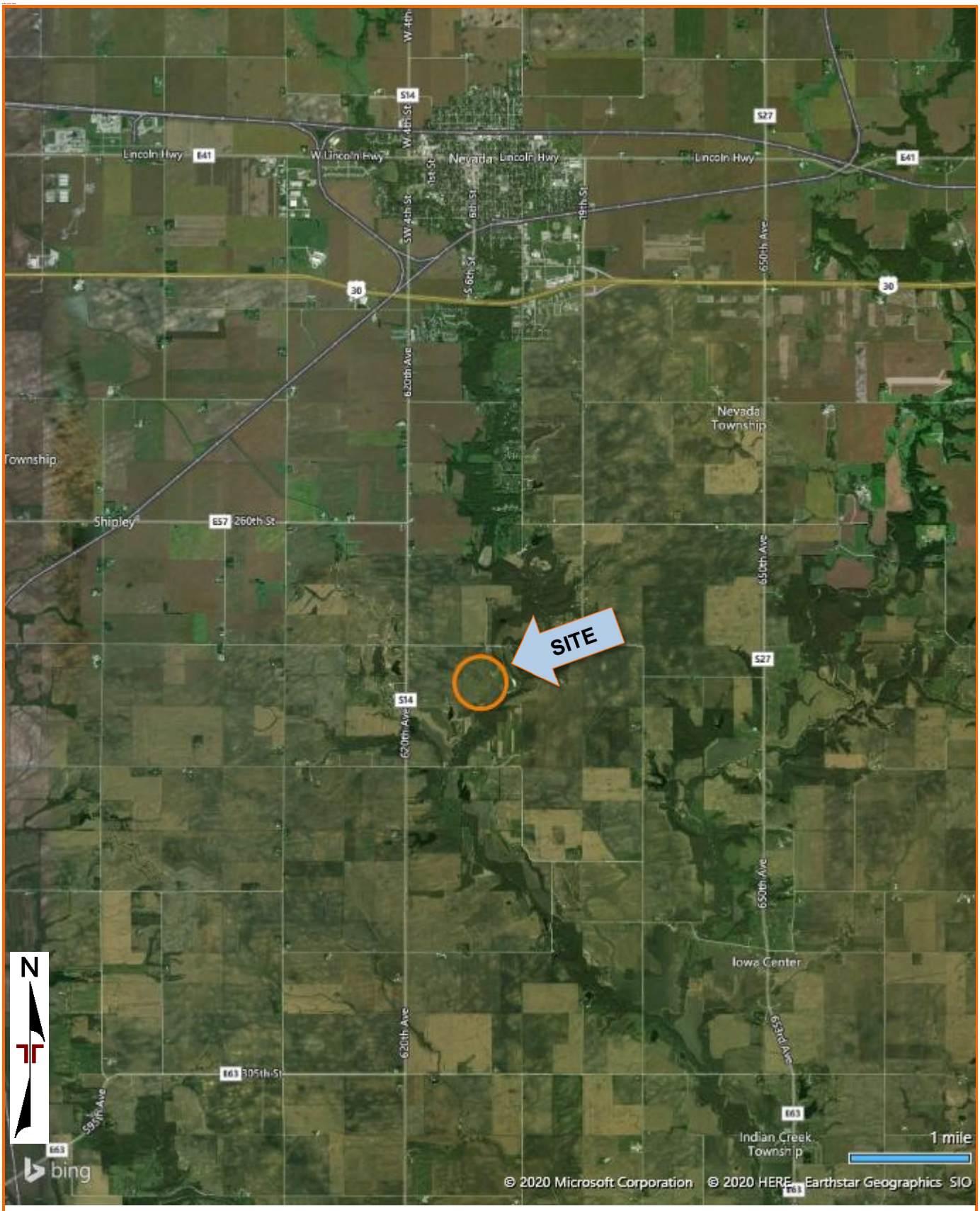


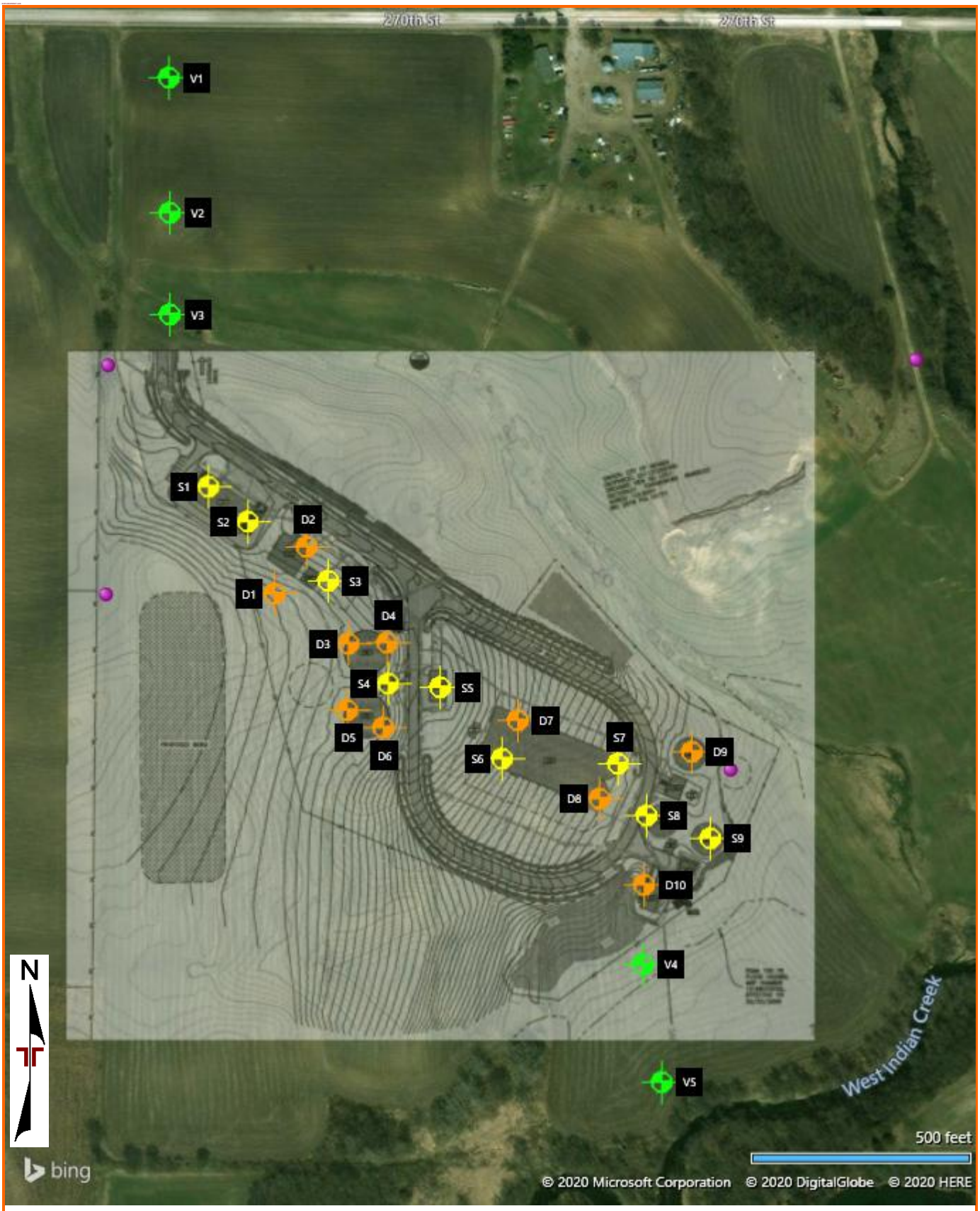
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Nevada Wastewater Treatment Facility ■ Nevada, Iowa

May 22, 2020 ■ Terracon Project No. 08205065-01



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MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

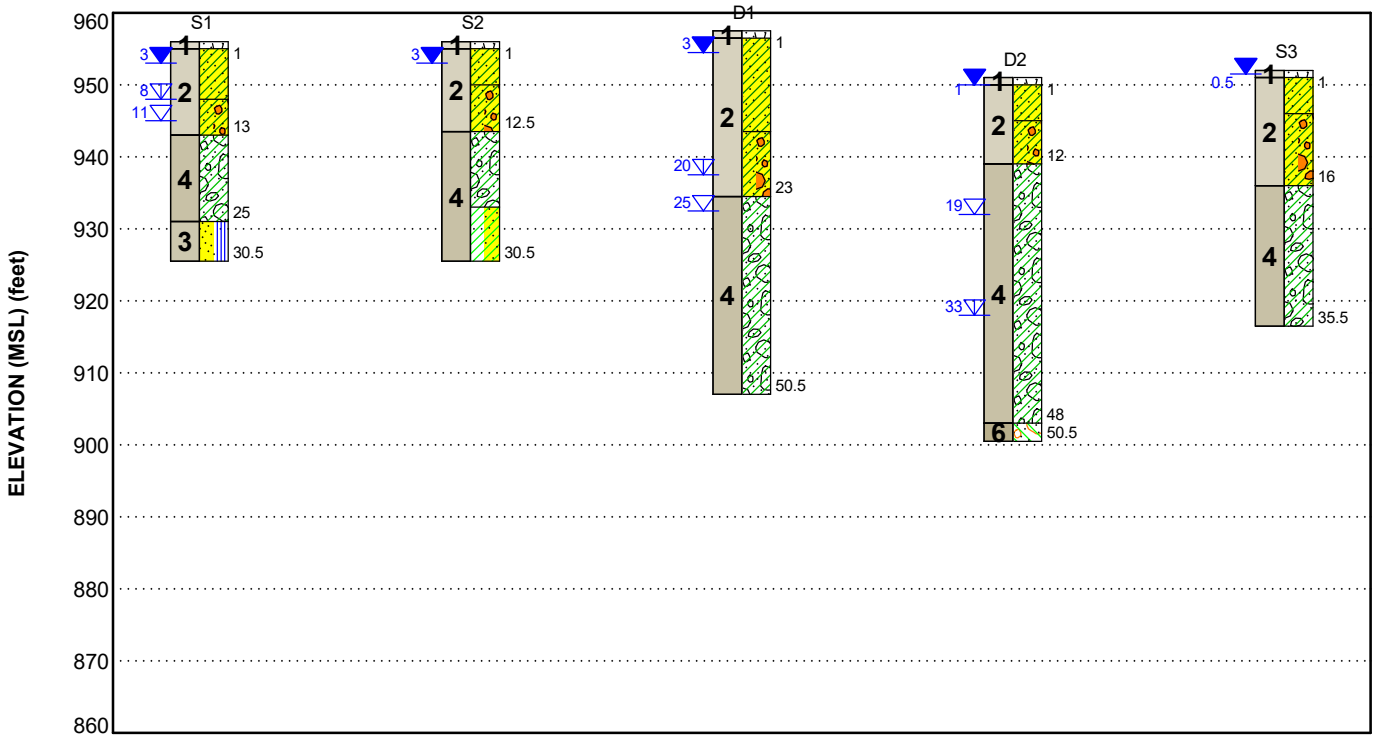
Contents:

GeoModels (5 pages)
Boring Logs (D1-D1, S1-S9 and V1-V5)
Grain Size Distribution

Note: All attachments are one page unless noted above.

GEOMODEL

Nevada WWTF Improvements ■ Story County, Iowa
Terracon Project No. 08205065



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Topsoil / Local Alluvium / Alluvium	Approx. 6" to 12" Root Zone/Plow Zone Lean Clay, trace to with sand, trace organics (CL) Lean to Fat Clay, trace sand, trace organics (CL/CH)
2	Wisconsinan Supraglacial Till	Sandy Lean Clay/Clayey Sand, trace gravel (CL/SC) Sandy Lean Clay, trace gravel (CL) Occasional sand seams
3	Glacial Outwash	Fine to Coarse Grained Sand, trace gravel (SP, SP-SM, SP-SC) With varying fines (silt and clay) content
4	Wisconsinan Subglacial Till	Sandy Lean Clay, trace gravel (CL) Lean Clay, with sand to trace sand and trace gravel (CL) Occasional sand seams
5	Loess	Lean Clay, trace sand (CL)
6	Pre-Illinoian Glacial Till	Sandy Lean Clay, trace gravel (CL) Occasional sand seams and cobbles

LEGEND

- Topsoil
- Sandy Lean Clay with Gravel
- Poorly-graded Sand with Silt
- Glacial Till
- Sandy Lean Clay
- Glacial Till
- Lean Clay with Sand

NOTES:

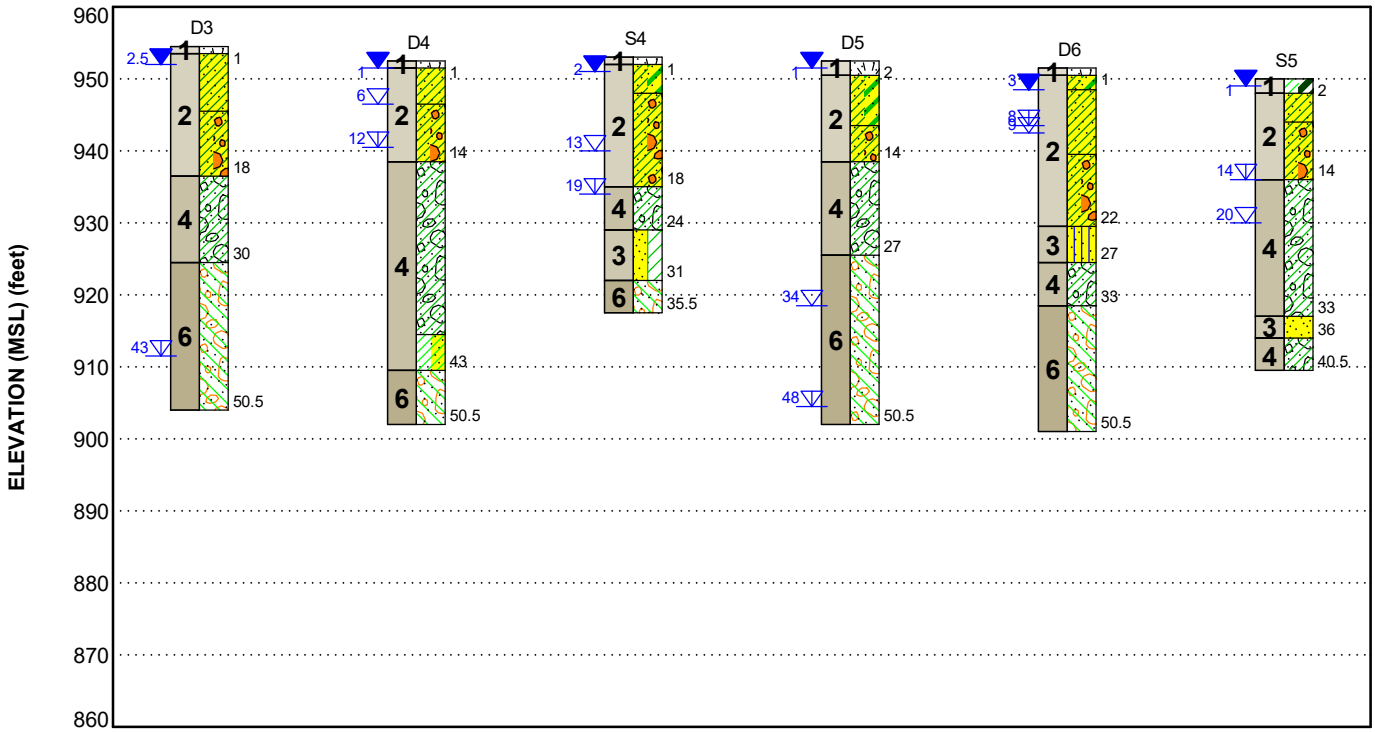
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

GEOMODEL

Nevada WWTF Improvements ■ Story County, Iowa
Terracon Project No. 08205065



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LEGEND

- Topsoil
- Sandy Lean Clay with Gravel
- Glacial Till
- Sandy Lean Clay/Clayey Sand
- Silty Sand
- Poorly-graded Sand
- Sandy Lean Clay
- Glacial Till
- Lean Clay with Sand
- Poorly-graded Sand with Clay
- Lean Clay/Fat Clay

NOTES:

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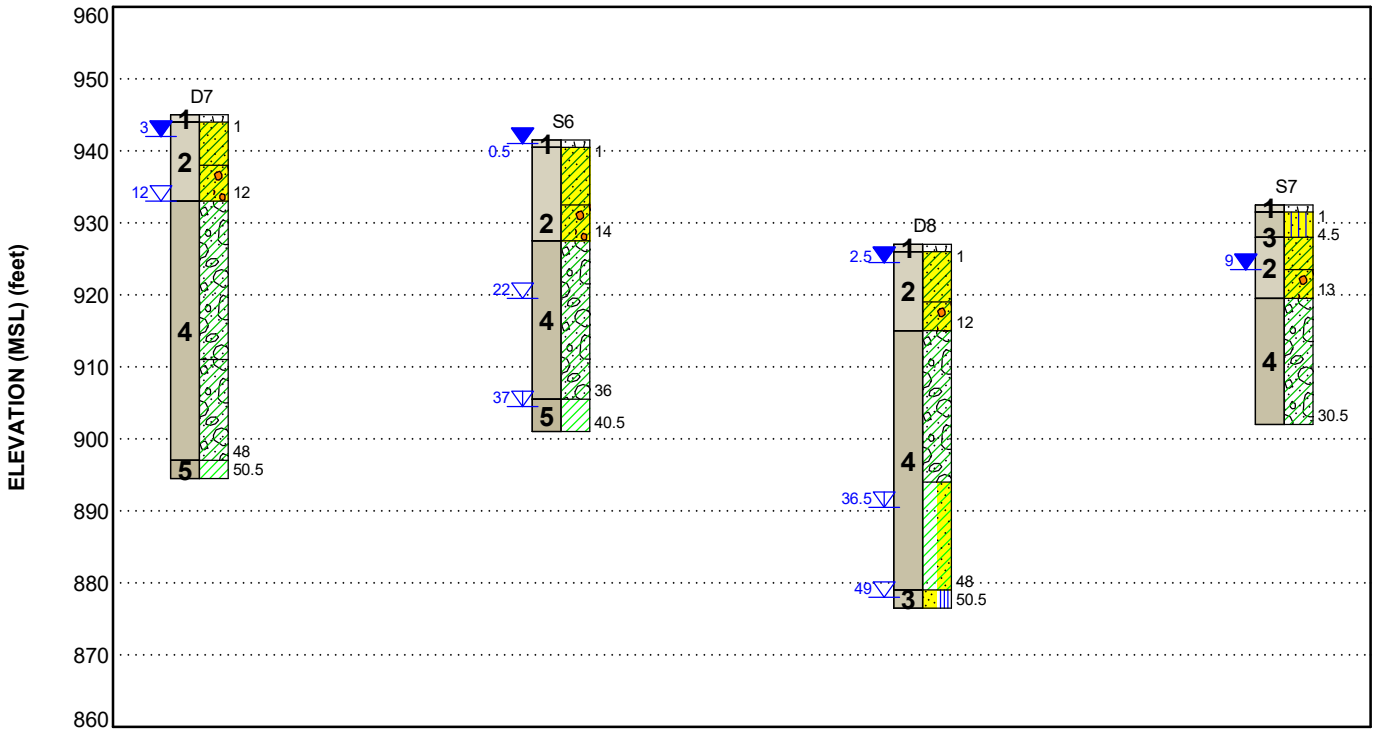
GEOMODEL

Nevada WWTF Improvements ■ Story County, Iowa
Terracon Project No. 08205065



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4	Wisconsinan Subglacial Till	Sandy Lean Clay, trace gravel (CL) Lean Clay, with sand to trace sand and trace gravel (CL) Occasional sand seams
5	Loess	Lean Clay, trace sand (CL)
6	Pre-Illinoian Glacial Till	Sandy Lean Clay, trace gravel (CL) Occasional sand seams and cobbles

LEGEND

- Topsoil
- Sandy Lean Clay
- Sandy Lean Clay with Gravel
- Glacial Till
- Lean Clay
- Lean Clay with Sand
- Poorly-graded Sand with Silt
- Silty Sand

NOTES:

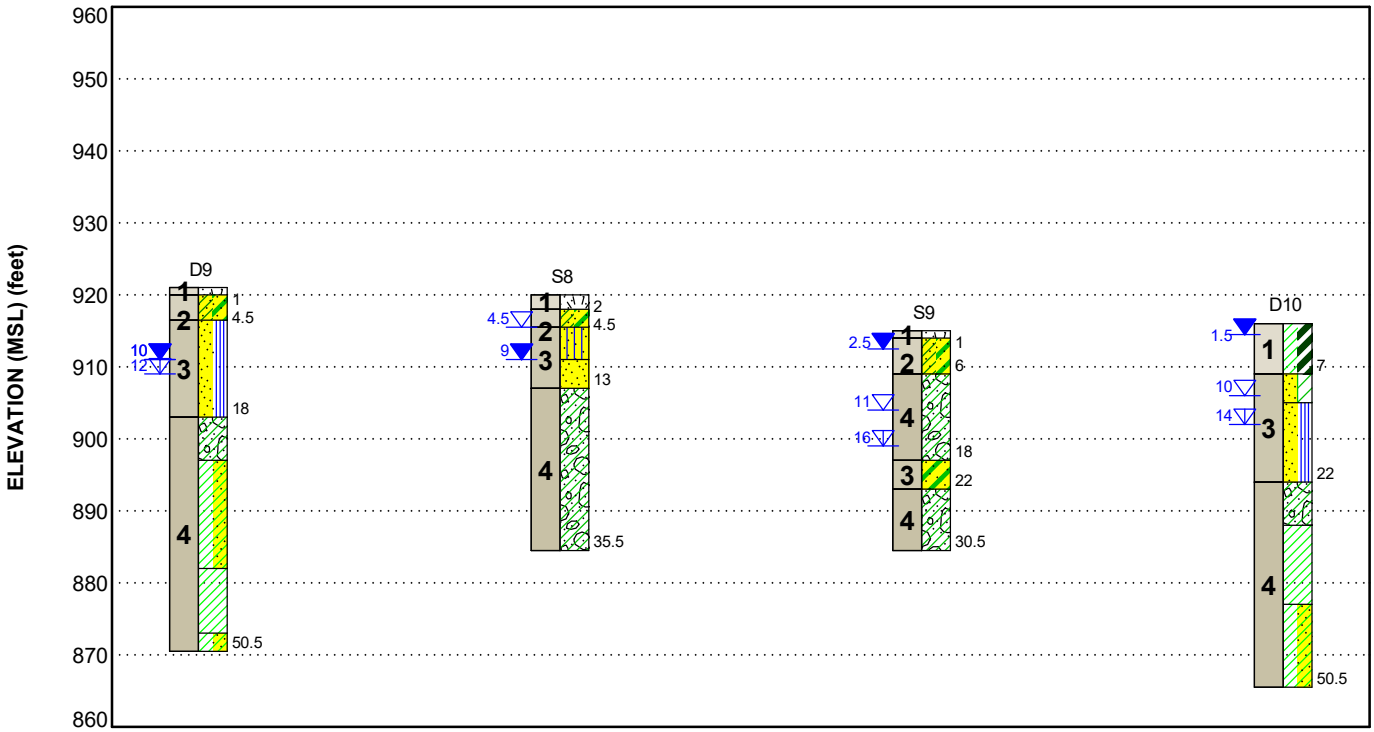
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

GEOMODEL

Nevada WWTF Improvements ■ Story County, Iowa
Terracon Project No. 08205065



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Topsoil / Local Alluvium / Alluvium	Approx. 6" to 12" Root Zone/Plow Zone Lean Clay, trace to with sand, trace organics (CL) Lean to Fat Clay, trace sand, trace organics (CL/CH)
2	Wisconsinan Supraglacial Till	Sandy Lean Clay/Clayey Sand, trace gravel (CL/SC) Sandy Lean Clay, trace gravel (CL) Occasional sand seams
3	Glacial Outwash	Fine to Coarse Grained Sand, trace gravel (SP, SP-SM, SP-SC) With varying fines (silt and clay) content
4	Wisconsinan Subglacial Till	Sandy Lean Clay, trace gravel (CL) Lean Clay, with sand to trace sand and trace gravel (CL) Occasional sand seams
5	Loess	Lean Clay, trace sand (CL)
6	Pre-Illinoian Glacial Till	Sandy Lean Clay, trace gravel (CL) Occasional sand seams and cobbles

LEGEND

- Topsoil
- Poorly-graded Sand with Silt
- Lean Clay with Sand
- Silty Sand
- Clayey Sand
- Poorly-graded Sand with Clay
- Sandy Lean Clay/Clayey Sand
- Glacial Till
- Lean Clay
- Poorly-graded Sand
- Lean Clay/Fat Clay

NOTES:

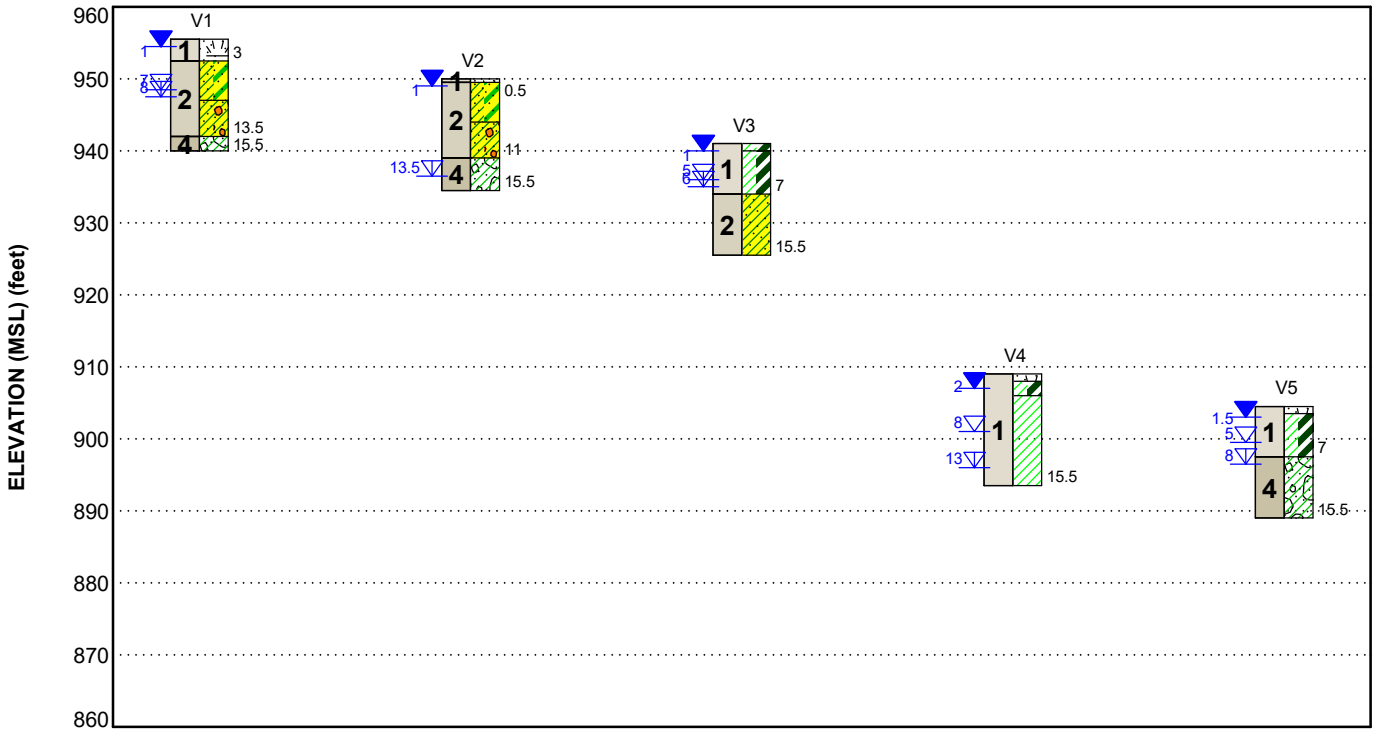
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

GEOMODEL

Nevada WWTF Improvements ■ Story County, Iowa
Terracon Project No. 08205065



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Topsoil / Local Alluvium / Alluvium	Approx. 6" to 12" Root Zone/Plow Zone Lean Clay, trace to with sand, trace organics (CL) Lean to Fat Clay, trace sand, trace organics (CL/CH)
2	Wisconsinan Supraglacial Till	Sandy Lean Clay/Clayey Sand, trace gravel (CL/SC) Sandy Lean Clay, trace gravel (CL) Occasional sand seams
3	Glacial Outwash	Fine to Coarse Grained Sand, trace gravel (SP, SP-SM, SP-SC) With varying fines (silt and clay) content
4	Wisconsinan Subglacial Till	Sandy Lean Clay, trace gravel (CL) Lean Clay, with sand to trace sand and trace gravel (CL) Occasional sand seams
5	Loess	Lean Clay, trace sand (CL)
6	Pre-Illinoian Glacial Till	Sandy Lean Clay, trace gravel (CL) Occasional sand seams and cobbles

LEGEND

- Topsoil
- Sandy Lean Clay with Gravel
- Lean Clay/Fat Clay
- Lean Clay
- Sandy Lean Clay/Clayey Sand
- Glacial Till
- Sandy Lean Clay

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

BORING LOG NO. D1

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9611° Longitude: -93.4528°

Approximate Surface Elev.: 957.5 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	956.5+/-	**Approx 12" Root Zone/Plow Zone**
2			**LEAN CLAY (CL)**, trace sand, trace organics, dark brown
			SANDY LEAN CLAY (CL), trace gravel, brown to brown with light gray, soft to medium stiff
			WISCONSINAN SUPRAGLACIAL TILL
	14.0	943.5+/-	
			SANDY LEAN CLAY, trace gravel, gray-brown with rusty brown, medium stiff to stiff
			WISCONSINAN SUPRAGLACIAL TILL
	23.0	934.5+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, very stiff
			Light gray fine sand seam at about 24'-25' (Sample #7)
			WISCONSINAN SUBGLACIAL TILL

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			18	1-2-1 N=3	1		18			
	▼		18	1-2-2 N=4	2		18			
5			18	2-3-3 N=6	3		5			
10			18	2-3-4 N=7	4		15			
15			18	3-3-4 N=7	5		15			
20	▽		18	2-5-5 N=10	6		12			
25	▽		18	6-12-9 N=21	7		13			
30			18	4-9-11 N=20	8		13			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *25' (elev. 932.5') During Drilling*
- ▽ *20' (elev. 937.5') After Drilling*
- ▼ *3' (elev. 954.5') 5 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D1

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9611° Longitude: -93.4528°

Approximate Surface Elev.: 957.5 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4		**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, very stiff *(continued)* dark gray with dark brown below about 34'										
		35		X	18	4-6-12 N=18	9		12			
		40		X	18	6-10-12 N=22	10		12			
		WISCONSINAN SUBGLACIAL TILL										
		45		X	18	5-8-10 N=18	11		13			
		50.5 907+/- 50		X	18	4-9-10 N=19	12		13			
		Boring Terminated at 50.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

25' (elev. 932.5') During Drilling

20' (elev. 937.5') After Drilling

3' (elev. 954.5') 5 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020 | Boring Completed: 04-08-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. D2

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9614° Longitude: -93.4526°

Approximate Surface Elev.: 951.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	950+/-	**Approx 12" Root Zone/Plow Zone** trace sand, trace organics, very dark brown
2	6.0	945+/-	**SANDY LEAN CLAY (CL)**, trace gravel, brown with light gray, soft to medium stiff. Occasional sand seams to about 6' **WISCONSINAN SUPRAGLACIAL TILL**
4	12.0	939+/-	**SANDY LEAN CLAY**, trace gravel, gray-brown with rusty brown, medium stiff **WISCONSINAN SUPRAGLACIAL TILL**
			SANDY LEAN CLAY, trace gravel, dark gray, medium stiff to very stiff **WISCONSINAN SUBGLACIAL TILL** Gray fine sand seam near 29'-30'

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
5		18	1-2-1 N=3	1	19
		18	1-2-2 N=4	2	23
		18	2-3-3 N=6	3	17
10		18	2-3-3 N=6	4	17
15		18	2-3-4 N=7	5	16
20		18	3-6-7 N=13	6	13
		18	3-6-9 N=15	7	14
25		18	4-6-7 N=13	8	17
30		18	4-7-10 N=17	9	12

WATER LEVEL OBSERVATIONS: 1' (elev. 950') 5 Days After Drilling; 19' (elev. 932') During Drilling; 33' (elev. 918') After Drilling

UNCONFINED COMPRESSIVE STRENGTH (psf) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- 19' (elev. 932') During Drilling
- 33' (elev. 918') After Drilling
- 1' (elev. 950') 5 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D2

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9614° Longitude: -93.4526°

Approximate Surface Elev.: 951.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4														
				35			18	4-7-8 N=15	10		15			
				40			18	3-3-4 N=7	11		18			
				45			18	3-4-7 N=11	12		17			
				50			13	4-22-14 N=36	13		14			
6		48.0	903+/-											
		50.5	900.5+/-											

SANDY LEAN CLAY, trace gravel, dark gray, medium stiff to very stiff *(continued)*

WISCONSINAN SUBGLACIAL TILL

SANDY LEAN CLAY, trace gravel, dark gray with dark brown, hard

PRE-ILLINOIAN GLACIAL TILL

Boring Terminated at 50.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *19' (elev. 932') During Drilling*
- *33' (elev. 918') After Drilling*
- *1' (elev. 950') 5 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D3

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9608° Longitude: -93.4522°

Approximate Surface Elev.: 954.5 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	953.5+/-	**Approx 12" Root Zone/Plow Zone**
2	9.0	945.5+/-	**LEAN CLAY (CL)**, trace sand, trace organics, dark brown **SANDY LEAN CLAY (CL)**, trace gravel, brown, soft to medium stiff brown with light gray and medium stiff to stiff below about 3' **WISCONSINAN SUPRAGLACIAL TILL**
4	18.0	936.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, stiff **WISCONSINAN SUPRAGLACIAL TILL**
6	30.0	924.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff Stiff to very stiff below about 23' **WISCONSINAN SUBGLACIAL TILL**
			SANDY LEAN CLAY (CL), trace gravel, dark yellow brown with light gray, stiff to very stiff **PRE-ILLINOIAN GLACIAL TILL**

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼	X	7	1-2-2 N=4	1		20			
		■	13		2	2000	16	113		
5		X	13	2-2-3 N=5	3		16			
10		■	16		4	2460	16	116		
		X	18	2-3-5 N=8	5		16			
15		■	8		6	2800	15	113		
20		X	18	2-2-3 N=5	7		17			
25		X	18	3-7-8 N=15	8		13			
30		X	18	3-5-6 N=11	9		15			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling
43' (elev. 911.5') After Drilling
2.5' (elev. 952') 5 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D3

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9608° Longitude: -93.4522°

Approximate Surface Elev.: 954.5 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
6		**SANDY LEAN CLAY (CL)**, trace gravel, dark yellow brown with light gray, stiff to very stiff *(continued)*										
		35		X	18	3-6-9 N=15	10		15			
		PRE-ILLINOIAN GLACIAL TILL										
		40	▽	X	18	4-5-7 N=12	11		3			
		45		X	18	3-8-9 N=17	12		12			
		Dark gray below about 47'										
		50.5 904+/- 50		X	18	4-8-10 N=18	13		12			
		Boring Terminated at 50.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling
43' (elev. 911.5') After Drilling
2.5' (elev. 952') 5 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D4

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9608° Longitude: -93.4519°

Approximate Surface Elev.: 952.5 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	MODEL LAYER	DESCRIPTION
1.0	951.5+/-	1	**Approx 12" Root Zone/Plow Zone**
		2	**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown
		2	**SANDY LEAN CLAY (CL)**, trace gravel, brown with light gray, soft to medium stiff Occasional sand seams to about 6' Sand seam in Sample #2
		2	**WISCONSINAN SUPRAGLACIAL TILL**
6.0	946.5+/-	2	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, medium stiff to stiff
		2	**WISCONSINAN SUPRAGLACIAL TILL**
14.0	938.5+/-	4	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff to stiff
		4	**WISCONSINAN SUBGLACIAL TILL**

DEPTH (Ft.)	SAMPLE ID	RECOVERY ()	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
	1	11	1-1-1 N=2		26	
	2	9	Sand Seam		21	102
5	3	18	2-2-3 N=5		15	
10	4	14		3320	15	118
	5	18	3-4-6 N=10			
15	6	16		2900	15	118
20	7	18	3-3-4 N=7		15	
25	8	18	3-4-5 N=9		14	
30	9	18	3-6-7 N=13		15	

ATTERBERG LIMITS: LL-PL-PI

PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *6' (elev. 946.5') During Drilling*
- *12' (elev. 940.5') After Drilling*
- *1' (elev. 951.5') 6 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020
Boring Completed: 04-07-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D4

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9608° Longitude: -93.4519°

Approximate Surface Elev.: 952.5 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4														
				35		X	18	4-5-6 N=11	10		14			
		38.0	914.5+/-											
				40		X	18	3-5-7 N=12	11		17			
		43.0	909.5+/-											
6				45		X	18	3-8-16 N=24	12		16			
		50.5	902+/-	50		X	18	3-7-10 N=17	13		11			

SANDY LEAN CLAY (CL), trace gravel, dark gray, medium stiff to stiff *(continued)*

WISCONSINAN SUBGLACIAL TILL

LEAN CLAY (CL), with sand, gray, stiff

WISCONSINAN SUBGLACIAL TILL

SANDY LEAN CLAY (CL), trace gravel, dark gray with dark brown, very stiff

PRE-ILLINOIAN GLACIAL TILL

Boring Terminated at 50.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *6' (elev. 946.5') During Drilling*
- *12' (elev. 940.5') After Drilling*
- *1' (elev. 951.5') 6 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020
Boring Completed: 04-07-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 08205065 NEVADA D1-V5 COPY.GPJ TERRACON_DATATEMPLATE.GDT 5/15/20

BORING LOG NO. D5

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9604° Longitude: -93.4523°

Approximate Surface Elev.: 952.5 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1				**Approx 12" Root Zone/Plow Zone**
		2.0	950.5+/-	**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown, medium stiff
2				**SANDY LEAN CLAY/CLAYEY SAND (CL/SC)**, trace gravel, brown with light gray, stiff to medium stiff
				WISCONSINAN SUPRAGLACIAL TILL
		9.0	943.5+/-	
				SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, stiff
				WISCONSINAN SUPRAGLACIAL TILL
		14.0	938.5+/-	
4				**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, very stiff
				Dark gray with dark brown below about 19'
				WISCONSINAN SUBGLACIAL TILL
		27.0	925.5+/-	
6				**SANDY LEAN CLAY (CL)**, trace gravel, yellow brown with light gray and rusty brown, stiff
				PRE-ILLINOIAN GLACIAL TILL

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼									
		X	15	2-3-3 N=6	1		37			
		■	6		2	2250	21	98		
5										
		X	18	2-2-3 N=5	3		19			
10		■	12		4	2380	14	114		
		X	18	3-5-5 N=10	5		15			
15		■	13		6	4270	14	117		
20		X	1	6-9-10 N=19	7		13			
25		X	18	6-8-8 N=16	8		15			
30		X	18	3-5-7 N=12	9		17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *34' (elev. 918.5') During Drilling*
- *48' (elev. 904.5') After Drilling*
- *1' (elev. 951.5') 3 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-10-2020
Boring Completed: 04-10-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D5

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9604° Longitude: -93.4523°

Approximate Surface Elev.: 952.5 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
6		**SANDY LEAN CLAY (CL)**, trace gravel, yellow brown with light gray and rusty brown, stiff *(continued)*										
		35			18	1-4-10 N=14	10		12			
		PRE-ILLINOIAN GLACIAL TILL 40			18	4-5-6 N=11	11		13			
		45			18	4-6-8 N=14	12		28			
		Dark gray and very stiff below about 48'										
		50.5 902+/- 50			18	4-6-9 N=15	13		13			
		Boring Terminated at 50.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *34' (elev. 918.5') During Drilling*
- *48' (elev. 904.5') After Drilling*
- *1' (elev. 951.5') 3 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-10-2020 | Boring Completed: 04-10-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. D6

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9603° Longitude: -93.452°

Approximate Surface Elev.: 951.5 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	
1	1.0	950.5+/-	**Approx 12" Root Zone/Plow Zone**
2	3.0	948.5+/-	**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown
			SANDY LEAN CLAY/CLAYEY SAND (CL/SC), trace gravel, brown to brown with light gray, soft to medium stiff
			SANDY LEAN CLAY (CL), trace gravel, brown with light gray, medium stiff to stiff
			WISCONSINAN SUPRAGLACIAL TILL
	12.0	939.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, stiff to very stiff
			WISCONSINAN SUPRAGLACIAL TILL
			No recovery in Sample #7
3	22.0	929.5+/-	**SILTY SAND (SM)**, fine to medium grained, trace coarse sand and gravel, gray, medium dense
			GLACIAL OUTWASH
4	27.0	924.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff
			WISCONSINAN SUBGLACIAL TILL
	33.0	918.5+/-	

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		18	1-2-1 N=3	1		18			
		15		2	2530	16	112		
5		18	2-3-3 N=6	3		17			
10		14		4	1130	18	112	27-15-12	53
		18	2-3-4 N=7	5		17			
15		15		6	3960	16	116		
20		0	9-11-10 N=21	7					
25		18	21-16-10 N=26	8		22			
30		18	2-3-4 N=7	9		21			

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

9' (elev. 942.5') During Drilling
8' (elev. 943.5') After Drilling
3' (elev. 948.5') 6 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020
Boring Completed: 04-07-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D6

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9603° Longitude: -93.452°

Approximate Surface Elev.: 951.5 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
6		**SANDY LEAN CLAY (CL)**, trace gravel, yellow brown with light gray and rusty brown, stiff										
		35		X	18	3-4-5 N=9	10		17			
		PRE-ILLINOIAN GLACIAL TILL										
		40		X	18	3-5-7 N=12	11		14			
		Very stiff below about 44'										
		45		X	18	3-7-8 N=15	12		14			
		Large gravel/cobble at about 50' (Sample #13)										
		50.5 901+/- 50		X	9	5-16-38 N=54	13					
		Boring Terminated at 50.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *9' (elev. 942.5') During Drilling*
- *8' (elev. 943.5') After Drilling*
- *3' (elev. 948.5') 6 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020
Boring Completed: 04-07-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D7

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9603° Longitude: -93.4508°

Approximate Surface Elev.: 945.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		1.0	944+/-											
2							7	2-1-1 N=2	1		19			
							9	1-2-1 N=3	2		26			
				5										
							5	3-4-5 N=9	3		17			
							18	2-3-5 N=8	4		16			
		7.0	938+/-											
		12.0	933+/-											
4				15			18	4-4-5 N=9	5		14			
				20			18	11-14-11 N=25	6		12			
				25			18	5-7-9 N=16	7		14			
				30			18	3-4-5 N=9	8		17			
							18	2-5-6	9		16			

Approx 12" Root Zone/Plow Zone

LEAN CLAY (CL), trace sand, trace organics, very dark brown

SANDY LEAN CLAY (CL), trace gravel, brown with light gray, soft
Occasional very sandy zones and sand seams to about 6'

WISCONSINAN SUPRAGLACIAL TILL

SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, stiff

WISCONSINAN SUPRAGLACIAL TILL

SANDY LEAN CLAY (CL), trace gravel, dark gray, stiff to very stiff

WISCONSINAN SUBGLACIAL TILL

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

12' (elev. 933') During Drilling

3' (elev. 942') 7 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D7

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9603° Longitude: -93.4508°

Approximate Surface Elev.: 945.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								N=11						
4		34.0	911+/-											
		SANDY LEAN CLAY (CL), trace gravel, dark gray, stiff		35			18	3-4-4 N=8	10		17		31-15-16	66
				40			18	2-4-4 N=8	11		17			
		WISCONSINAN SUBGLACIAL TILL												
				45			18	2-4-4 N=8	12		18			
		48.0	897+/-											
5		**LEAN CLAY (CL)**, trace sand and wood, gray, medium stiff **LOESS**												
		50.5	894.5+/-	50			18	2-4-5 N=9	13		24			
		Boring Terminated at 50.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

12' (elev. 933') During Drilling

3' (elev. 942') 7 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D8

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9599° Longitude: -93.4501°

Approximate Surface Elev.: 927.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	926+/-	**Approx 12" Root Zone/Plow Zone**
2			**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown
			SANDY LEAN CLAY (CL), trace gravel, brown to light brown with light gray, medium stiff
			WISCONSINAN SUPRAGLACIAL TILL
	8.0	919+/-	
			SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, stiff
			WISCONSINAN SUPRAGLACIAL TILL
	12.0	915+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff to stiff
			WISCONSINAN SUBGLACIAL TILL
	33.0	894+/-	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼	X	18	2-2-2 N=4	1		19			
		X	18	2-2-3 N=5	2		17			
5										
		X	18	3-4-3 N=7	3		17			
10		X	18	3-4-5 N=9	4		15			
		■	11		5	3990	15	116		
15		X	18	3-4-4 N=8	6		17			
20		X	18	3-3-4 N=7	7		16			
25		X	18	3-4-4 N=8	8		17			
30		X	18	3-3-4 N=7	9		17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *49' (elev. 878') During Drilling*
- *36.5' (elev. 890.5') After Drilling*
- *2.5' (elev. 924.5') 3 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-10-2020
Boring Completed: 04-10-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D8

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9599° Longitude: -93.4501°

Approximate Surface Elev.: 927.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4			**LEAN CLAY WITH SAND (CL)**, gray to dark gray, medium stiff to stiff											
				35			18	2-3-4 N=7	10		24			
					▽									
			WISCONSINAN SUBGLACIAL TILL	40			18	4-6-7 N=13	11		22			
				45			18	4-5-5 N=10	12		20			
		48.0	879+/-											
3			**SAND (SP-SM)**, fine to medium grained, trace coarse sand and fines, gray, very loose		▽									
		50.5	**GLACIAL OUTWASH** 876.5+/-	50			18	1-1-1 N=2	13		17			
			Boring Terminated at 50.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *49' (elev. 878') During Drilling*
- ▽ *36.5' (elev. 890.5') After Drilling*
- ▼ *2.5' (elev. 924.5') 3 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-10-2020 | Boring Completed: 04-10-2020
Drill Rig: 709 | Driller: SK
Project No.: 08205065

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 08205065 NEVADA D1-V5 COPY.GPJ TERRACON_DATATEMPLATE.GDT 5/15/20

BORING LOG NO. D9

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9602° Longitude: -93.4493°

Approximate Surface Elev.: 921.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	920+/-	**Approx 12" Root Zone/Plow Zone**
2			**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown
			SANDY LEAN CLAY/CLAYEY SAND (CL/SC), trace gravel, brown to brown with light gray, soft
	4.5	916.5+/-	**WISCONSINAN SUPRAGLACIAL TILL**
3			**SAND (SP-SM)**, fine to coarse grained, with fines, trace gravel, dark reddish brown, loose to medium dense Coarse sand and gravel content decreasing below about 6'
			GLACIAL OUTWASH
			No Recovery in Sample #5
	18.0	903+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff
			WISCONSINAN SUBGLACIAL TILL
	24.0	897+/-	
			LEAN CLAY WITH SAND (CL), gray to dark gray, stiff
			WISCONSINAN SUBGLACIAL TILL

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			18	2-2-3 N=5	1		18			
			18	2-2-1 N=3	2		5			
5			18	3-4-5 N=9	3		4			
10	▼ ▽		18	3-5-5 N=10	4		19		NP	7
15			0	3-4-5 N=9	5					
20			18	3-3-4 N=7	6		16			
			18	1-2-4 N=6	7		17			
25			18	3-4-5 N=9	8		19			
30			18	4-7-7 N=14	9		21			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *10' (elev. 911') During Drilling*
- ▽ *12' (elev. 909') After Drilling*
- ▼ *10' (elev. 911') 4 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-09-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D9

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9602° Longitude: -93.4493°

Approximate Surface Elev.: 921.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4														
			LEAN CLAY WITH SAND (CL), gray to dark gray, stiff *(continued)* dark gray with brown below 34'											
				35		X	18	3-6-7 N=13	10		19			
			WISCONSINAN SUBGLACIAL TILL											
		39.0	882+/-											
			LEAN CLAY (CL), trace sand, gray to dark gray, stiff	40		X	18	3-5-6 N=11	11		21			
			WISCONSINAN SUBGLACIAL TILL	45		X	18	3-4-5 N=9	12		24			
		48.0	873+/-											
			LEAN CLAY WITH SAND (CL), dark gray, stiff											
			WISCONSINAN SUBGLACIAL TILL	50		X	18	3-4-5 N=9	13		16			
		50.5	870.5+/-											
			Boring Terminated at 50.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *10' (elev. 911') During Drilling*
- *12' (elev. 909') After Drilling*
- *10' (elev. 911') 4 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-09-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D10

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9593° Longitude: -93.4497°

Approximate Surface Elev.: 916.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	
1				**Approx 12" Root Zone/Plow Zone**
				LEAN TO FAT CLAY (CL), trace sand, trace organics, very dark gray
				LOCAL ALLUVIUM
		7.0	909+/-	
3				**SAND (SP-SC)**, fine to coarse grained, with gravel and trace clay, gray with brown, loose
				GLACIAL OUTWASH
		11.0	905+/-	
				SAND (SP-SM), fine to coarse grained, with gravel and trace silt, brown with gray, medium dense to dense
				Occasional gravel or cobble seams to 22'
				GLACIAL OUTWASH
				Loose below at about 20' (No recovery in Sample #7)
		22.0	894+/-	
4				**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff
				WISCONSINAN SUBGLACIAL TILL
		28.0	888+/-	
				LEAN CLAY (CL), trace sand, dark gray, medium stiff
				WISCONSINAN SUBGLACIAL TILL

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼		18	2-2-4 N=6	1		29			
			17		2	2280	32	84		
5										
			18	2-2-3 N=5	3		29			
10	▽		11	Sand	4		13			
			10	6-7-10 N=17	5		12			
	▽									
15			2	12-24-12 N=36	6		14			
20			0	3-4-5 N=9	7					
25			18	2-3-3 N=6	8		20			
30			18	2-2-2 N=4	9		30			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *10' (elev. 906') During Drilling*
- ▽ *14' (elev. 902') After Drilling*
- ▼ *1.5' (elev. 914.5') 4 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. D10

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9593° Longitude: -93.4497°

Approximate Surface Elev.: 916.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4														
			LEAN CLAY (CL), trace sand, dark gray, medium stiff *(continued)*											
				35		X	18	2-3-3 N=6	10		26			
			WISCONSINAN SUBGLACIAL TILL											
		39.0	877+/-											
			LEAN CLAY WITH SAND (CL), dark gray, stiff	40		X	18	2-4-4 N=8	11		25			
			WISCONSINAN SUBGLACIAL TILL	45		X	18	3-4-5 N=9	12		21			
		50.5	865.5+/-	50		X	3	4-5-6 N=11	13		29			
			Boring Terminated at 50.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *10' (elev. 906') During Drilling*
- *14' (elev. 902') After Drilling*
- *1.5' (elev. 914.5') 4 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S1

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9618° Longitude: -93.4534°

Approximate Surface Elev.: 956.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
1	1.0	955+/-	**Approx 12" Root Zone/Plow Zone**
2	8.0	948+/-	**LEAN CLAY (CL)**, with sand, trace organics, very dark brown **SANDY LEAN CLAY (CL)**, trace gravel, brown with light gray, medium stiff to stiff Occasional sand seams to about 8' **WISCONSINAN SUPRAGLACIAL TILL**
2	13.0	943+/-	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, stiff to very stiff **WISCONSINAN SUPRAGLACIAL TILL**
4	25.0	931+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff Occasional sand seams to about 25' Very stiff below about 18' **WISCONSINAN SUBGLACIAL TILL**
3	30.5	925.5+/-	**SAND (SP-SM)**, with gravel, trace silt, gray, medium dense **GLACIAL OUTWASH**
			Boring Terminated at 30.5 Feet

DEPTH (Ft.)	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	18	1-1-1 N=2	1		16			
	10		2	2240	16	114		
5	18	2-3-3 N=6	3		16			
10	17	5500 psf (HP)	4		16	117		
	2	3-5-6 N=11	5					
15	15		6	2850	13	119		
20	18	3-7-13 N=20	7		11			
25	24	3-6-12-21 N=18	8		14			
30	18	4-6-7 N=13	9		11			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *11' (elev. 945') During Drilling*
- *8' (elev. 948') After Drilling*
- *3' (elev. 953') 5 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S2

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9616° Longitude: -93.4531°

Approximate Surface Elev.: 956.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	955+/-	**Approx 12" Root Zone/Plow Zone**
2			**LEAN CLAY (CL)**, with sand, trace organics, very dark brown
			SANDY LEAN CLAY (CL), trace gravel, brown with light gray and rusty brown, medium stiff to stiff
			WISCONSINAN SUPRAGLACIAL TILL
	6.0	950+/-	
			SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, medium stiff to stiff
			WISCONSINAN SUPRAGLACIAL TILL
	12.5	943.5+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, very stiff to stiff
			WISCONSINAN SUBGLACIAL TILL
	23.0	933+/-	
			LEAN CLAY (CL), with sand, gray, stiff
			WISCONSINAN SUBGLACIAL TILL
	30.5	925.5+/-	
			Boring Terminated at 30.5 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		2	1-2-2 N=4	1		17			
		15		2	2460	16	117		
5		18	2-2-3 N=5	3		16			
10		15		4	3410	15	116		
		18	2-4-4 N=8	5		15			
15		16		6	4090	15	118		
20		18	2-4-4 N=8	7		10			
25		18	5-6-8 N=14	8		19			
30		18	2-3-4 N=7	9		24			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling

None Observed After Drilling

3' (elev. 953') 6 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020 | Boring Completed: 04-07-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. S3

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9612° Longitude: -93.4524°

Approximate Surface Elev.: 952.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	951+/-	**Approx 12" Root Zone/Plow Zone**
2			**LEAN CLAY (CL)**, trace sand, trace organics, dark brown
			SANDY LEAN CLAY (CL), trace gravel, brown with light gray, medium stiff Occasional sand seams to about 6'
			WISCONSINAN SUPRAGLACIAL TILL
	6.0	946+/-	
			SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, soft to medium stiff
			WISCONSINAN SUPRAGLACIAL TILL
	16.0	936+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff
			WISCONSINAN SUBGLACIAL TILL

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		18	2-2-3 N=5	1		15			
		18	2-2-3 N=5	2		17			
5		18	2-2-3 N=5	3		35			
10		18	2-2-2 N=4	4		17			
15		5	2-3-4 N=7	5		16			
		16		6	3330	15	119		
20		18	2-4-5 N=9	7		13			
25		18	3-7-7 N=14	8		13			
30		18	3-5-5 N=10	9		12			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling

None Observed After Drilling

0.5' (elev. 951.5') 6 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020 | Boring Completed: 04-07-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. S3

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9612° Longitude: -93.4524°

Approximate Surface Elev.: 952.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff *(continued)*											
		35.5	916.5+/-	35		X	18	2-5-5 N=10	10		14			
			Boring Terminated at 35.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling

None Observed After Drilling

0.5' (elev. 951.5') 6 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020 | Boring Completed: 04-07-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. S4

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9606° Longitude: -93.4519°

Approximate Surface Elev.: 953.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	952+/-	**Approx 12" Root Zone/Plow Zone**
2			**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown
			SANDY LEAN CLAY/CLAYEY SAND (CL/SC), trace gravel, brown with light gray, soft
	5.0	948+/-	**WISCONSINAN SUPRAGLACIAL TILL**
			SANDY LEAN CLAY (CL), trace gravel, gray-brown with light gray and rusty brown, medium stiff to stiff
			WISCONSINAN SUPRAGLACIAL TILL
	18.0	935+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, gray to dark gray with brown, stiff
			WISCONSINAN SUBGLACIAL TILL
			Very stiff to hard below 22'
	24.0	929+/-	
3			**SAND (SP-SC)**, fine to coarse grained, trace gravel, gray, medium dense
			GLACIAL OUTWASH
			Gravel and cobble content at about 28'-30'
	31.0	922+/-	
6			**SANDY LEAN CLAY (CL)**, trace gravel, olive gray, very stiff
			PRE-ILLINOIAN GLACIAL TILL

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼		8	2-2-1 N=3	1		25			
			12	1-1-1 N=2	2		25			
5			18	2-3-4 N=7	3		17			
10			18	2-4-4 N=8	4		15			
	▽									
15			18	3-6-7 N=13	5		14			
	▽									
20			18	2-4-4 N=8	6		15			
		■	21		7	8120	16	117		
25			18	4-10-7 N=17	8		17			
30			18	11-16-13 N=29	9		8			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *13' (elev. 940') During Drilling*
- ▽ *19' (elev. 934') After Drilling*
- ▼ *2' (elev. 951') 7 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-07-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S4

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9606° Longitude: -93.4519°

Approximate Surface Elev.: 953.0 (Ft.) +/-

DEPTH ELEVATION (Ft.)

MODEL LAYER	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
6		**SANDY LEAN CLAY (CL)**, trace gravel, olive gray, very stiff *(continued)*											
		35.5 917.5+/-	35			18	4-8-10 N=18	10		12			
		Boring Terminated at 35.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

13' (elev. 940') During Drilling

19' (elev. 934') After Drilling

2' (elev. 951') 7 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020 Boring Completed: 04-07-2020

Drill Rig: 709 Driller: SK

Project No.: 08205065

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BORING LOG NO. S5

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9605° Longitude: -93.4515°

Approximate Surface Elev.: 950.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	2.0	948+/-	**Approx 12" Root Zone/Plow Zone** **LEAN TO FAT CLAY (CL/CH)**, trace sand, trace organics, very dark gray
2	6.0	944+/-	**SANDY LEAN CLAY (CL)**, trace gravel, brown with light gray, soft to medium stiff **WISCONSINAN SUPRAGLACIAL TILL**
2	14.0	936+/-	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, stiff **WISCONSINAN SUPRAGLACIAL TILL**
4	33.0	917+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray with brown to dark gray, stiff **WISCONSINAN SUBGLACIAL TILL** Very stiff in Sample #7

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)
		14	2-2-1 N=3	1	25
		8	1-2-2 N=4	2	19
5		18	2-4-4 N=8	3	14
10		15	2-5-6 N=11	4	16
15		15	3-4-6 N=10	5	15
20		15	1-4-4 N=8	6	14
25		18	3-7-8 N=15	7	13
		18	3-6-8 N=14	8	13
30		18	4-6-7 N=13	9	25

WATER LEVEL OBSERVATIONS

UNCONFINED COMPRESSIVE STRENGTH (psf)

DRY UNIT WEIGHT (pcf)

ATTERBERG LIMITS: LL-PL-PI

PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *20' (elev. 930') During Drilling*
- *14' (elev. 936') After Drilling*
- *1' (elev. 949') 6 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020
Boring Completed: 04-07-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S5

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9605° Longitude: -93.4515°

Approximate Surface Elev.: 950.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
3														
				35		X	18	8-10-7 N=17	10		8			
4														
				40		X	18	3-7-8 N=15	11		16			

SAND (SP), fine to coarse grained, trace gravel and fines, gray, medium dense

GLACIAL OUTWASH

36.0 914+/-

SANDY LEAN CLAY (CL), trace gravel, dark gray, very stiff

WISCONSINAN SUBGLACIAL TILL

40.5 909.5+/-

Boring Terminated at 40.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

20' (elev. 930') During Drilling

14' (elev. 936') After Drilling

1' (elev. 949') 6 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-07-2020 | Boring Completed: 04-07-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. S6

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9601° Longitude: -93.451°

Approximate Surface Elev.: 941.5 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	940.5+/-	**Approx 12" Root Zone/Plow Zone**
2	9.0	932.5+/-	**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown **SANDY LEAN CLAY (CL)**, trace gravel, brown with light gray and rusty brown, medium stiff **WISCONSINAN SUPRAGLACIAL TILL**
4	14.0	927.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, stiff **WISCONSINAN SUPRAGLACIAL TILL** **SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff Very stiff in Sample #6 **WISCONSINAN SUBGLACIAL TILL** Large gravel/cobbles below about 30'

SAMPLE ID	RECOVERY ()	FIELD TEST RESULTS	WATER CONTENT (%)
1	10	2-2-2 N=4	19
2	18	2-2-3 N=5	16
3	18	2-3-3 N=6	15
4	18	3-3-5 N=8	14
5	18	2-5-6 N=11	13
6	18	4-6-9 N=15	11
7	18	2-4-5 N=9	15
8	11	5-5-5 N=10	20

DEPTH (Ft.): 5, 10, 15, 20, 25, 30

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

UNCONFINED COMPRESSIVE STRENGTH (psf)

DRY UNIT WEIGHT (pcf)

ATTERBERG LIMITS LL-PL-PI

PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

22' (elev. 919.5') During Drilling

37' (elev. 904.5') After Drilling

0.5' (elev. 941') 5 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020

Boring Completed: 04-08-2020

Drill Rig: 709

Driller: SK

Project No.: 08205065

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BORING LOG NO. S6

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9601° Longitude: -93.451°

Approximate Surface Elev.: 941.5 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4		**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff *(continued)* **WISCONSINAN SUBGLACIAL TILL**	36.0 905.5+/-	35			4	2-4-4 N=8	9					
5		**LEAN CLAY (CL)**, trace sand, gray, medium stiff **LOESS**	40.5 901+/-	40			18	3-3-3 N=6	10		24			
		Boring Terminated at 40.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *22' (elev. 919.5') During Drilling*
- *37' (elev. 904.5') After Drilling*
- *0.5' (elev. 941') 5 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-08-2020
Boring Completed: 04-08-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S7

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9601° Longitude: -93.45°

Approximate Surface Elev.: 932.5 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	1.0	931.5+/-	**Approx 12" Root Zone/Plow Zone**
3			**LEAN CLAY (CL)**, trace sand, trace organics, dark brown
			SILTY SAND (SM), fine to medium grained, brown to light brown, loose Occasional sandy clay seams to about 4.5'
	4.5	928+/-	**GLACIAL OUTWASH**
2			**SANDY LEAN CLAY (CL)**, trace gravel, brown to light brown with light gray, medium stiff
			WISCONSINAN SUPRAGLACIAL TILL
	9.0	923.5+/-	
			SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, stiff
			WISCONSINAN SUPRAGLACIAL TILL
	13.0	919.5+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff
			Medium stiff at about 20' (Sample #7)
			WISCONSINAN SUBGLACIAL TILL
	30.5	902+/-	
			Boring Terminated at 30.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			18	2-3-3 N=6	1		14			
			18	3-4-3 N=7	2		14			
5			18	3-3-4 N=7	3		15			
	▼		18	3-4-5 N=9	4		16			
10										
15			18	3-4-6 N=10	5		15			
			16		6	3700	17	112		
20			18	3-3-4 N=7	7		16			
25			18	3-5-7 N=12	8		14			
30			18	3-4-6 N=10	9		13			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling

None Observed After Drilling

▼ *9' (elev. 923.5') 3 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-10-2020 | Boring Completed: 04-10-2020

Drill Rig: 709 | Driller: SK

Project No.: 08205065

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BORING LOG NO. S8

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9598° Longitude: -93.4497°

Approximate Surface Elev.: 920.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1			**Approx 12" Root Zone/Plow Zone**
	2.0	918+/-	**LEAN CLAY (CL)**, trace sand, trace organics, very dark brown, medium stiff
2			**SANDY LEAN CLAY/CLAYEY SAND (CL/SC)**, trace gravel, dark reddish brown, medium stiff
	4.5	915.5+/-	**WISCONSINAN SUPRAGLACIAL TILL**
3			**SILTY SAND (SM)**, fine to medium grained, trace coarse sand, dark yellowish brown, very loose
			GLACIAL OUTWASH
	9.0	911+/-	
			SAND (SP), fine to coarse sand, trace gravel and fines, brown, loose
			GLACIAL OUTWASH
	13.0	907+/-	
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff
			WISCONSINAN SUBGLACIAL TILL
			Stiff at about 30' (Sample #9)

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		X	18	1-2-2 N=4	1		22			
	▽	X	12	2-2-2 N=4	2		19			
5		X	18	1-1-1 N=2	3		29			
	▼	X	18	3-4-4 N=8	4		17			
10										
15		X	18	2-3-3 N=6	5		19			
		X	18	2-2-2 N=4	6		18			
20		X	18	2-3-3 N=6	7		18			
25		X	18	2-3-4 N=7	8		17			
30		X	18	3-3-5 N=8	9		18			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

▽ *4.5' (elev. 915.5') During Drilling*

▼ *9' (elev. 911') 4 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-09-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S8

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9598° Longitude: -93.4497°

Approximate Surface Elev.: 920.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
4			**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, medium stiff *(continued)*											
		35.5	884.5+/-	35			18	2-3-4 N=7	10		17			
			Boring Terminated at 35.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

4.5' (elev. 915.5') During Drilling

9' (elev. 911') 4 Days After Drilling

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-09-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. S9

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9596° Longitude: -93.4492°

Approximate Surface Elev.: 915.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1		1.0	914+/-	**Approx 12" Root Zone/Plow Zone**
2		6.0	909+/-	**LEAN CLAY (CL)**, with sand, trace organics, dark brown **SANDY LEAN CLAY/CLAYEY SAND (CL/SC)**, trace gravel, dark reddish brown, soft to medium stiff **WISCONSINAN SUPRAGLACIAL TILL**
4		18.0	897+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff **WISCONSINAN SUBGLACIAL TILL**
3		22.0	893+/-	**CLAYEY SAND (SC)**, fine to coarse grained, trace gravel, gray, loose **GLACIAL OUTWASH**
4		30.5	884.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff **WISCONSINAN SUBGLACIAL TILL**
				Boring Terminated at 30.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼	Split Spoon	18	2-2-1 N=3	1		15			
		Shelby Tube	20		2	550	19	106		
5		Split Spoon	18	3-3-5 N=8	3		15			
10	▽	Shelby Tube	11		4	2590	15	114		
		Split Spoon	18	3-3-5 N=8	5		15			
15	▽	Shelby Tube	9		6	3030	15	117		
20		Split Spoon	18	4-4-4 N=8	7		15			
25		Split Spoon	18	3-3-6 N=9	8		16			
30		Split Spoon	18	3-3-6 N=9	9		17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25 ID Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *11' (elev. 904') During Drilling*
- ▽ *16' (elev. 899') After Drilling*
- ▼ *2.5' (elev. 912.5') 4 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-09-2020
Boring Completed: 04-09-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. V1

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9644° Longitude: -93.4538°

Approximate Surface Elev.: 955.5 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1														
							8	2-3-3 N=6	1		23			
		3.0	952.5+/-											
2							8	1500 psf (HP)	2	430	20	90		
				5										
							18	2-3-3 N=6	3		18			
		8.5	947+/-											
				10			18	3-3-4 N=7	4		17			
		13.5	942+/-											
4		15.5	940+/-	15			18	3-4-6 N=10	5		15			

Approx 12" Root Zone/Plow Zone

LEAN CLAY (CL), with sand, trace organics, very dark brown, medium stiff

SANDY LEAN CLAY/CLAYEY SAND (CL/SC), trace gravel, brown to brown with light gray, soft to medium stiff
Occasional very sandy zones/sand seams to about 8.5'

WISCONSINAN SUPRAGLACIAL TILL

SANDY LEAN CLAY (CL), trace gravel, gray-brown with rusty brown, medium stiff

WISCONSINAN SUPRAGLACIAL TILL

SANDY LEAN CLAY (CL), trace gravel, dark gray, stiff

WISCONSINAN SUBGLACIAL TILL

Boring Terminated at 15.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" OD Continuous Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *7' (elev. 948.5') During Drilling*
- *8' (elev. 947.5') After Drilling*
- *1' (elev. 954.5') 7 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. V2

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9635° Longitude: -93.4538°

Approximate Surface Elev.: 950.0 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	DESCRIPTION
1	0.5	949.5+/-	**Approx 6" Root Zone/Plow Zone**
2	6.0	944+/-	**LEAN CLAY (CL)**, with sand, trace organics, very dark brown **SANDY LEAN CLAY/CLAYEY SAND (CL/SC)**, trace gravel, brown to brown with light gray and rusty brown, medium stiff to stiff **WISCONSINAN SUPRAGLACIAL TILL**
4	11.0	939+/-	**SANDY LEAN CLAY (CL)**, trace gravel, gray-brown with rusty brown, stiff **WISCONSINAN SUPRAGLACIAL TILL**
	15.5	934.5+/-	**SANDY LEAN CLAY (CL)**, trace gravel, dark gray, stiff **WISCONSINAN SUBGLACIAL TILL**
			Boring Terminated at 15.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	▼									
		X	18	2-3-3 N=6	1		16			
		■	23		2	2590	16	116		
5										
		X	18	3-4-6 N=10	3		16			
10		■	23		4	3910	16	116		
	▽									
15		X	18	3-4-4 N=8	5		14			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" OD Continuous Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

None Observed During Drilling
▽ *13.5' (elev. 936.5') After Drilling*
▼ *1' (elev. 949') 7 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

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BORING LOG NO. V3

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9629° Longitude: -93.4538°

Approximate Surface Elev.: 941.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		1.0	940+/-											
		Approx 12" Root Zone/Plow Zone												
		LEAN TO FAT CLAY (CL/CH), trace sand and organics, very dark gray					9	2-3-3 N=6	1		31			
		LEAN TO FAT CLAY (CL/CH), trace sand, very dark gray, medium stiff to soft					10		2	730	24	85		
		LOCAL ALLUVIUM		5										
		7.0	934+/-				9	1-1-1 N=2	3		41			
2		**SANDY LEAN CLAY (CL)**, trace gravel, light gray, soft												
		Occasional sand seams to about 11'												
		No recovery in Sample #4		10			0		4					
		Brown with light gray and rusty brown below about 11', stiff												
		WISCONSINAN SUPRAGLACIAL TILL												
		15.5	925.5+/-	15			10	3-6-7 N=13	5		15			
		Boring Terminated at 15.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" OD Continuous Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *5' (elev. 936') During Drilling*
- *6' (elev. 935') After Drilling*
- *1' (elev. 940') 7 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 08205065 NEVADA D1-V5 COPY.GPJ TERRACON_DATATEMPLATE.GDT 5/15/20

BORING LOG NO. V4

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9588° Longitude: -93.4497°

Approximate Surface Elev.: 909.0 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		1.0	908+/-											
1							15	2-2-3 N=5	1		19			
		3.0	906+/-											
							8		2	560	17	91	33-20-13	58
				5										
							18	2-1-1 N=2	3		25			
				10			24		4	890	29	88		
		15.5	893.5+/-	15			18	2-3-3 N=6	5		20			

Approx 12" Root Zone/Plow Zone

LEAN CLAY (CL), trace sand, trace organics, very dark gray

LEAN TO FAT CLAY (CL/CH), trace sand, very dark gray, medium stiff to soft

LOCAL ALLUVIUM

LEAN CLAY (CL), trace sand and roots, gray, soft

ALLUVIUM

Lean clay with sand and medium stiff below about 13'

Boring Terminated at 15.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" OD Continuous Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *8' (elev. 901') During Drilling*
- *13' (elev. 896') After Drilling*
- *2' (elev. 907') 7 Days After Drilling*

Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 08205065 NEVADA D1-V5 COPY.GPJ TERRACON_DATATEMPLATE.GDT 5/15/20

BORING LOG NO. V5

PROJECT: Nevada WWTF Improvements

CLIENT: HR Green, Inc.
Johnston, Iowa

SITE: R22W, T83N, NE 1/4 Sec 31 Nevada Twp
Story County, Iowa

LOCATION See Exploration Plan

Latitude: 41.9581° Longitude: -93.4496°

Approximate Surface Elev.: 904.5 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE ID	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		1.0	903.5+/-											
1		**Approx 12" Root Zone/Plow Zone**												
		LEAN CLAY (CL), trace sand, trace organics, very dark gray					12	2-2-2 N=4	1		30			
		LEAN TO FAT CLAY (CL/CH), trace sand, very dark gray, medium stiff to soft					19		2	860	34	82		
		LOCAL ALLUVIUM		5										
		7.0	897.5+/-				18	2-3-4 N=7	3		18			
4		**SANDY LEAN CLAY (CL)**, trace gravel, dark gray with brown, very stiff to stiff												
				10			24		4	7330	19	117		
		WISCONSINAN SUBGLACIAL TILL												
		15.5	889+/-	15			18	3-4-6 N=10	5		14			
		Boring Terminated at 15.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4" OD Continuous Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by HR Green.

Notes:

WATER LEVEL OBSERVATIONS

- *5' (elev. 899.5') During Drilling*
- *8' (elev. 896.5') After Drilling*
- *1.5' (elev. 903') 7 Days After Drilling*

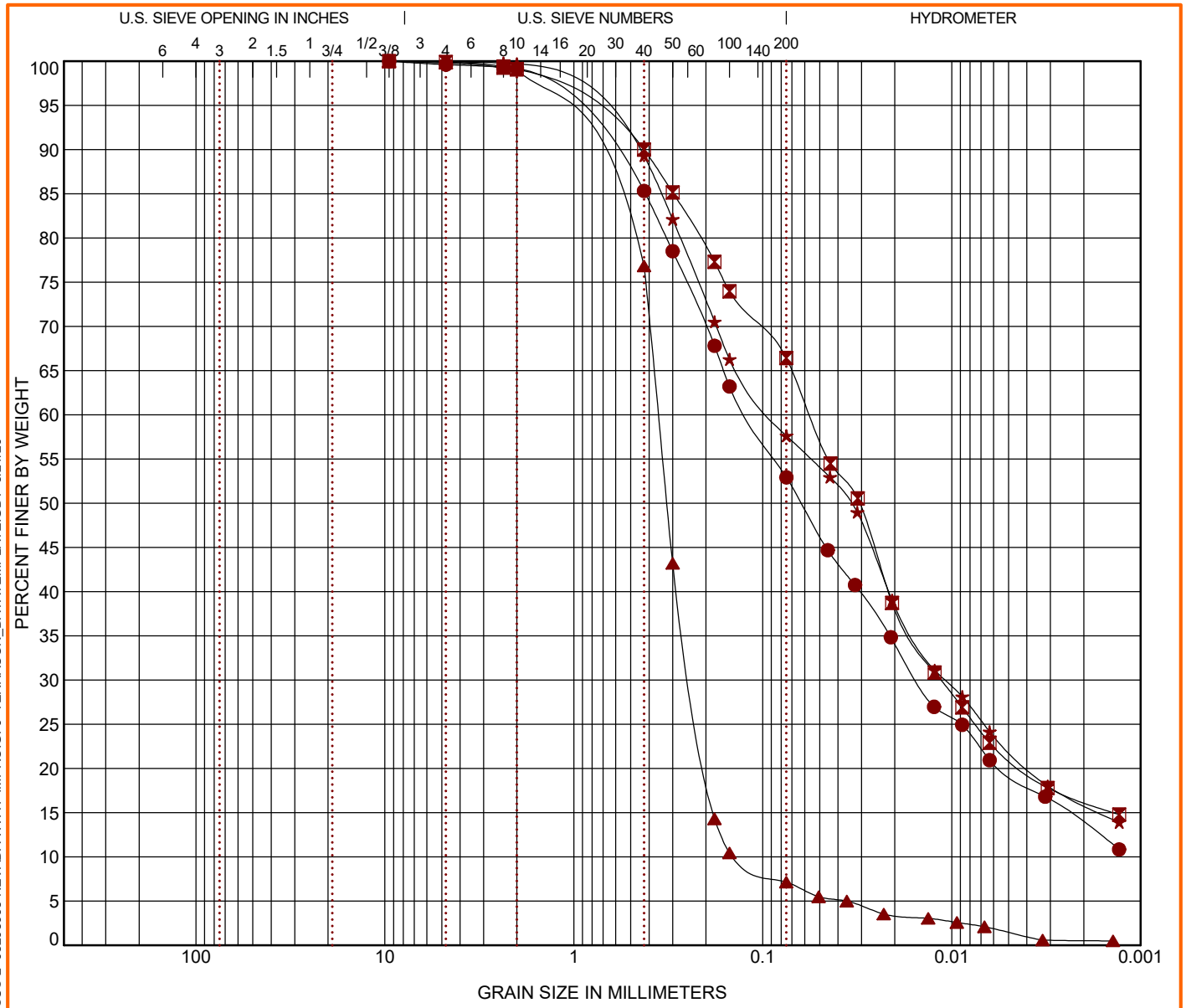
Terracon
600 SW 7th St, Ste M
Des Moines, IA

Boring Started: 04-06-2020
Boring Completed: 04-06-2020
Drill Rig: 709
Driller: SK
Project No.: 08205065

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 08205065 NEVADA D1-V5 COPY.GPJ TERRACON_DATATEMPLATE.GDT 5/15/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample ID	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	D6	SANDY LEAN CLAY (CL)	18	27	15	12		
⊠	D7	SANDY LEAN CLAY (CL)	17	31	15	16		
▲	D9	POORLY GRADED SAND with SILT (SP-SM)	19	NP	NP	NP	1.15	2.61
★	V4	LEAN CLAY, trace SAND (CL)	17	33	20	13		

	Sample ID	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	D6	9.5	0.121	0.015		0.0	0.4	46.7	33.4		19.5
⊠	D7	9.5	0.056	0.011		0.0	0.1	33.5	45.2		21.2
▲	D9	9.5	0.357	0.238	0.137	0.0	0.2	92.7	5.7		1.5
★	V4	9.5	0.091	0.011		0.0	0.1	42.3	35.5		22.2

PROJECT: Nevada WWTF Improvements

SITE: R22W, T83N, NE 1/4 Sec 31
Nevada Twp
Story County, Iowa

Terracon
600 SW 7th St, Ste M
Des Moines, IA

PROJECT NUMBER: 08205065-01

CLIENT: HR Green, Inc.
Johnston, Iowa

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 08205065 NEVADA WWTF IMPRO.GPJ TERRACON_DATATEMPLATE.GDT 5/21/20

SUPPORTING INFORMATION

Contents:

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING		WATER LEVEL	FIELD TESTS	
Auger	Split Spoon	Water Initially Encountered	(HP)	Hand Penetrometer
Shelby Tube	Macro Core	Water Level After a Specified Period of Time	(T)	Torvane
Ring Sampler	Rock Core	Water Level After a Specified Period of Time	(b/f)	Standard Penetration Test (blows per foot)
Grab Sample	No Recovery	Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	(PID)	Photo-Ionization Detector
			(OVA)	Organic Vapor Analyzer
			(DCP)	Dynamic Cone Penetrometer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve) Consistency determined by laboratory shear strength testing, field visual-manual procedures, or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, tsf	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 – 3	Very Soft	Less than 0.25	0 – 1
Loose	4 – 9	Soft	0.25 to 0.50	2 – 4
Medium Dense	10 – 29	Medium Stiff	0.50 to 1.00	4 – 8
Dense	30 – 50	Stiff	1.00 to 2.00	8 – 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 – 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive term(s) of other constituents	Percent (%) of dry weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major component of sample	Particle size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive term(s) of other constituents	Percent (%) of dry weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ³ 4 and 1 £ Cc £ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ³ 6 and 1 £ Cc £ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ³ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ³ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ³ 30% plus No. 200 predominantly sand, add "sandy" to group name.

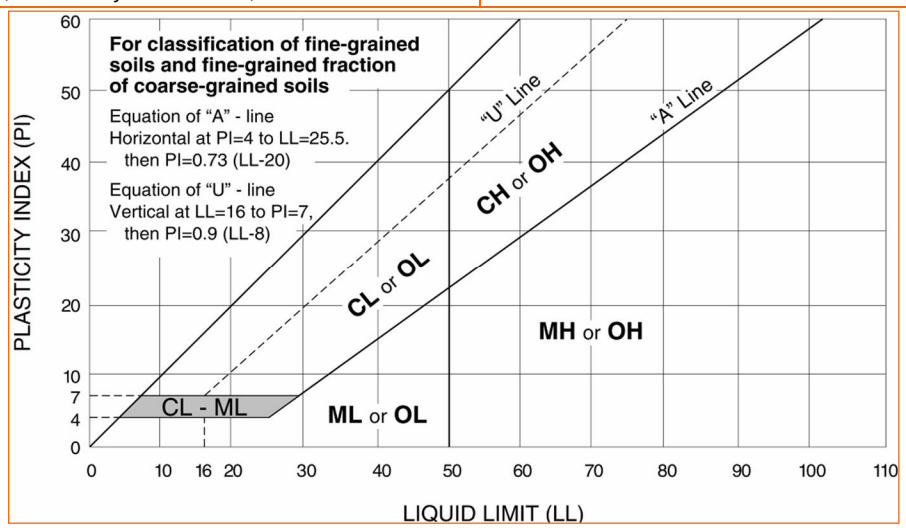
[M] If soil contains ³ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ³ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

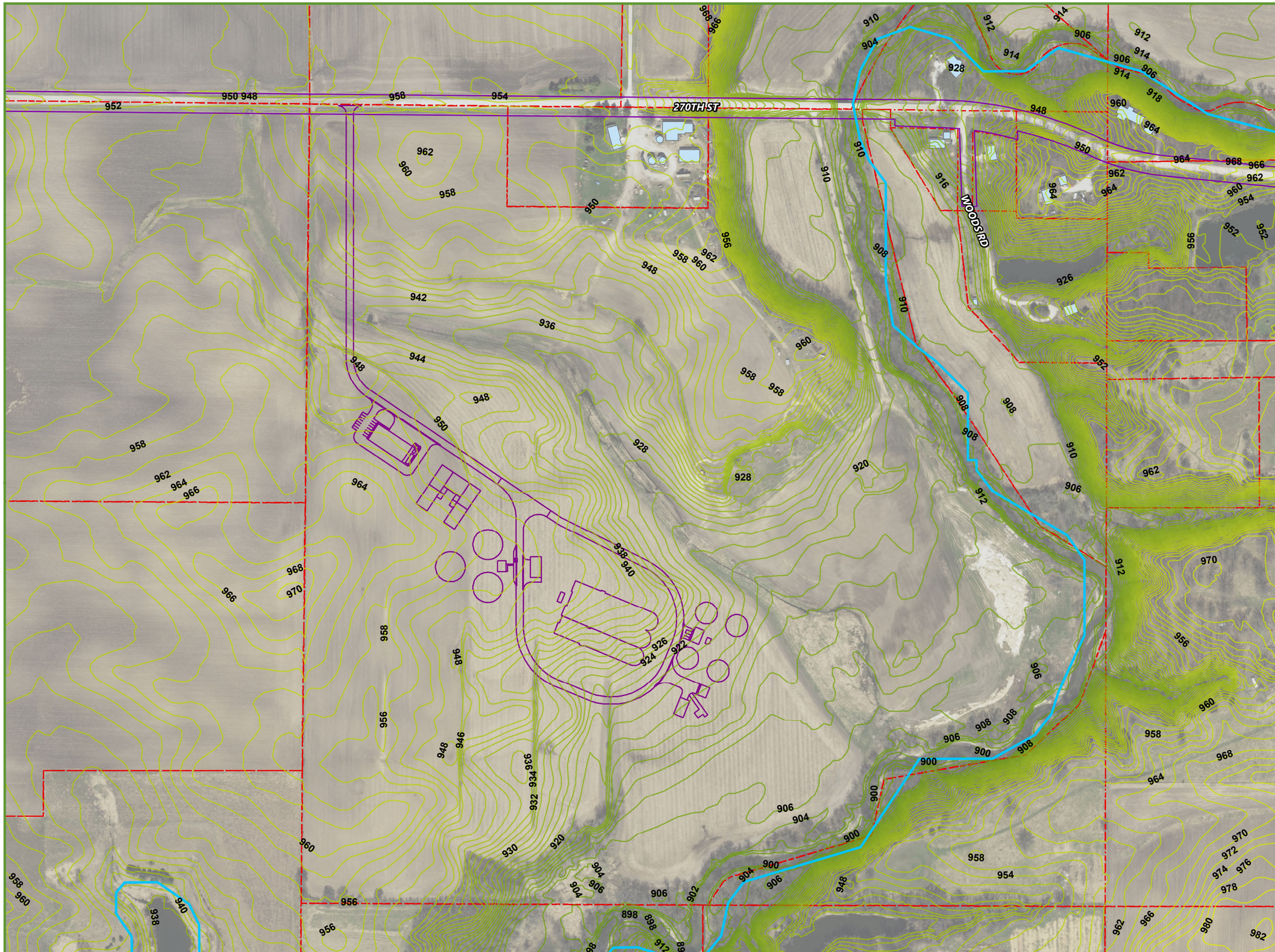
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Appendix B

DRAFT



Nevada WWTP

Existing Topography

Legend

- Rivers
- Proposed Nevada WWTP Design
- Parcels
- Building Footprint

0 300 600 Feet

1 inch = 300 feet

HRGreen

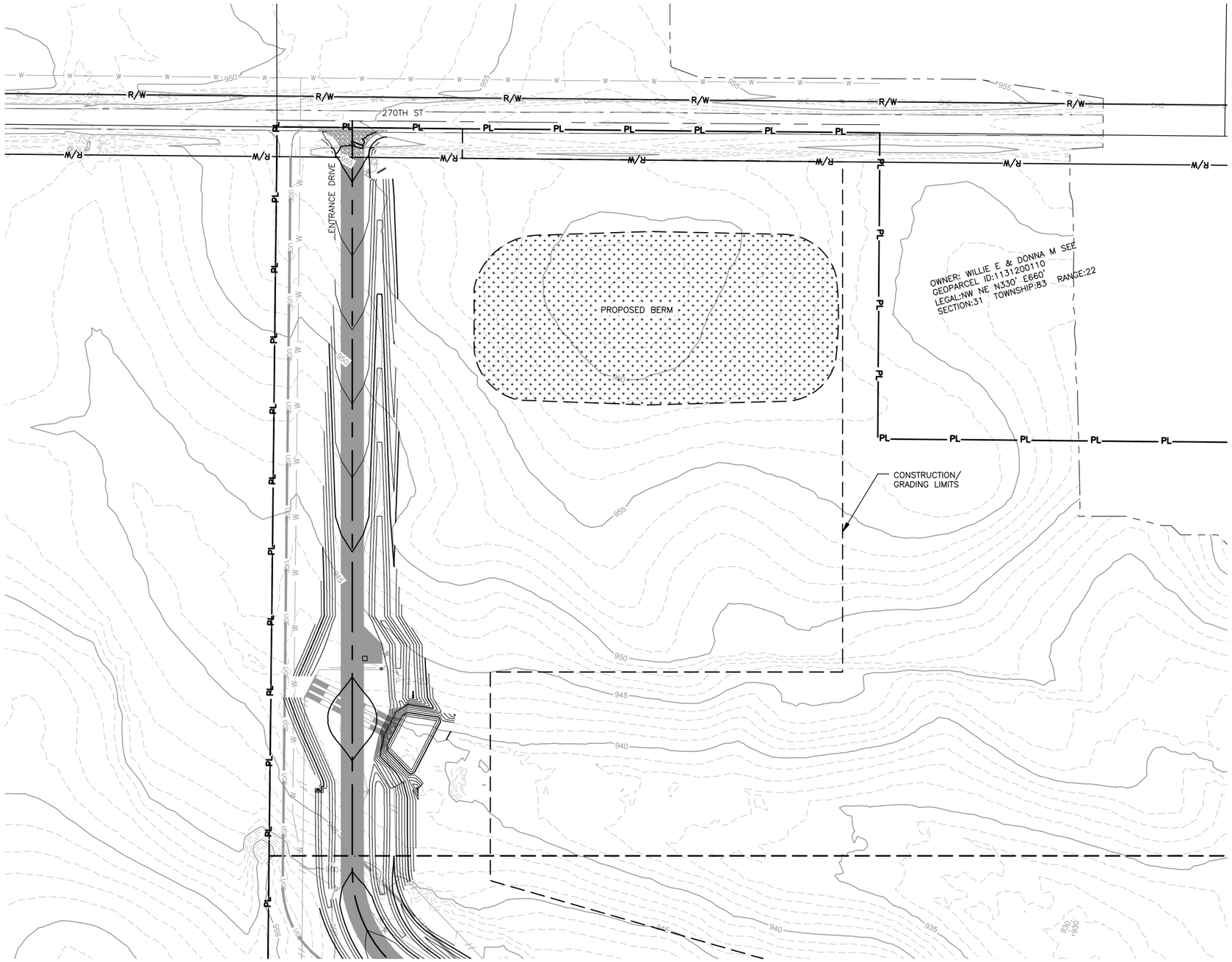
HRG PLOT: 2:41:10 PM 8/7/2020 BY: jgutman FILE: J:\2016\160473\Design\Meeting\Drainage Meeting\90%\Stormwater Management Plan\Topography\Topography.mxd

Appendix C

DRAFT

GENERAL NOTES:

1. REFER TO C.04 PLANT GRADING PLAN FOR GENERAL NOTES REGARDING SITE GRADING REQUIREMENTS.



1 SITEWORK
ENTRANCE GRADING PLAN
SCALE: 1"=60'

NORTH

PRELIMINARY
NOT FOR CONSTRUCTION

DRAWN BY: CMB, JST	JOB DATE: 2020	BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"	
APPROVED: MAR	JOB NUMBER: 160473	IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.	
CAD DATE: 8/2/2020 6:44:18 AM			
CAD FILE: J:\2016\160473\CAD\Dwgs\C\C.03 ENTRANCE GRADING PLAN.dwg			

NO.	DATE	BY	REVISION DESCRIPTION

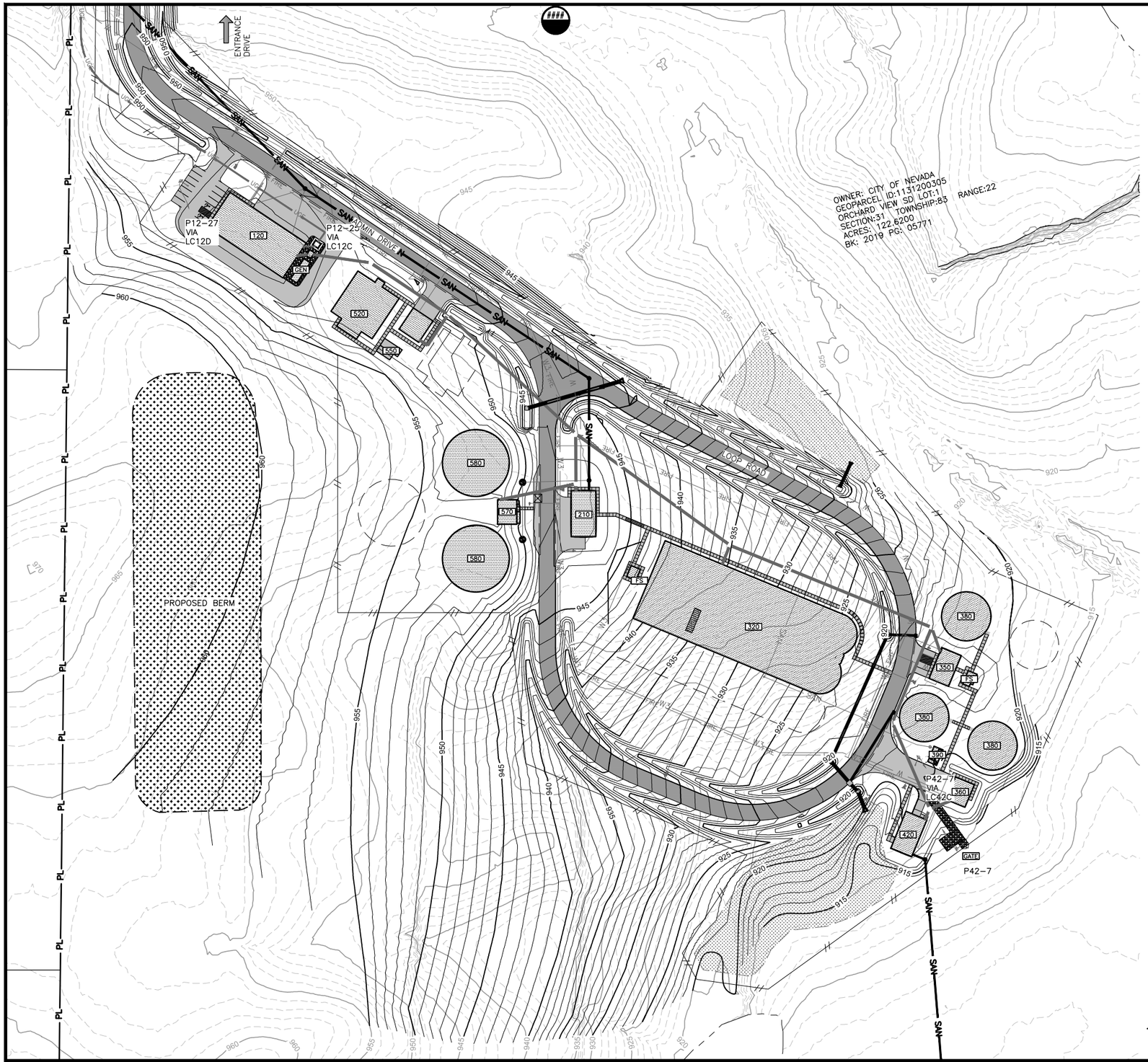
HRGreen.com
HRGreen

NEVADA WWTF IMPROVEMENTS
CITY OF NEVADA
NEVADA, IOWA

SITE WORK
ENTRANCE GRADING PLAN

SHEET NO.
C.03

Xrefs: xgl-1-dh01; XCS-BASE; XCS-DSGN; XCS-PARCELS; XCS-ROW; XCS-VIEWFRAME; XCU-ELEC; XCP-PATT; XCU-WATR; XCU-SANI; XCU-STRM; XCT-ALIGNMENT; XVG-CONT-EG; XCG-CONSTRUCTION-LIMITS; XLS-PATT; XLS-DSGN; XCG-CONT-FG



GENERAL NOTES:

1. SEE SHEET X.XX FOR GEOTECHNICAL REQUIREMENTS AROUND BUILDINGS AND TANKS.
2. CONTRACTOR SHALL COMPLY WITH SPECIFICATION SECTION XX XXXX FOR SUPPORTS AND PROTECTION.
3. CONTRACTOR SHALL COMPLY WITH ALL SPECIFICATIONS FOR DEWATERING, GRADING, EXCAVATION, FILL AND BACKFILL, AND TRENCHING. SEE GEOTECHNICAL INVESTIGATION REPORT FOR EARTHWORK RECOMMENDATIONS. INSTALL EARTHWORK ACCORDING TO SPECIFICATION AND RECOMMENDATIONS OF GEOTECHNICAL INVESTIGATION REPORT.
4. WATER LEVELS WERE OBSERVED WITHIN THE DEPTHS OF PLANNED EXCAVATION FOR THE PROPOSED STRUCTURES. DEWATERING WILL BE REQUIRED WHERE SEEPAGE IS ENCOUNTERED. GROUNDWATER LEVELS SHOULD BE MAINTAINED AT LEAST TWO FEET BELOW BOTTOM OF EXCAVATION UNTIL FOUNDATION SLABS ARE COMPLETED. THE CONTRACTOR IS RESPONSIBLE FOR EMPLOYING APPROPRIATE DEWATERING METHODS TO CONTROL SEEPAGE INTO THE EXCAVATION. SEE GEOTECHNICAL REPORT FOR MORE INFORMATION ON DEWATERING.
5. IN AREAS TO ACCEPT FILL, THE TOP 12 INCHES OF THE GROUND SURFACE SHALL BE SCARIFIED AND COMPACTED TO ELIMINATE A PLANE OF WEAKNESS ALONG THE CONTACT SURFACE. EACH LIFT PLACED ABOVE THE FOUNDATION LEVEL SHOULD BE COMPACT TO AT LEAST 95 PERCENT OF THE SOIL'S STANDARD PROCTOR DRY DENSITY (ASTM D698). THE MOISTURE CONTENT OF THE COHESIVE SOILS SHOULD BE MAINTAINED WITHIN A RANGE OF 0 PERCENT BELOW TO 4 PERCENT ABOVE THE MATERIAL'S STANDARD PROCTOR OPTIMUM MOISTURE CONTENT. GENERAL FILL MATERIAL TO COMPLY WITH SPECIFICATIONS AND SHALL BE FREE OF FOREIGN SUBSTANCE, DEBRIS, LARGE STONES, ROCKS, ROOTS, ORGANIC OR FROZEN MATERIAL, EXPANSIVE MATERIAL AND OTHER DELETERIOUS MATERIALS. UNSUITABLE SHALL BE DISPOSED OF BY THE CONTRACTOR.
6. FILL SHOULD NOT BE FROZEN AND SHOULD NOT BE PLACED ON A FROZEN SURFACE. ALL COHESIVE SOILS USED AS FILL AT THIS SITE SHOULD HAVE A MAXIMUM LIQUID LIMIT OF 45 AND A MAXIMUM PLASTICITY INDEX OF 20.
7. ENSURE THAT PREVIOUSLY COMPACTED LIFTS ARE SCARIFIED 2 INCHES DEEP PRIOR TO COMPACTING THE NEXT LIFT.
8. USE EXISTING TOPSOIL STOCKPILE PLACED UNDER PRIOR CONTRACT TO PLACE 8" TOPSOIL TO MATCH FINAL GRADE ELEVATIONS AS SHOWN ON PLANS, EXCEPT IN AREAS TO BE SURFACED WITH GRAVEL, PAVEMENT, RIPRAP, OR OTHER DESIGNATED MATERIALS. REMOVE, STOCKPILE, AND REPLACE NATIVE MATERIAL 8 INCHES (TOPSOIL) BELOW EXISTING SURFACE FOR ALL AREAS DISTURBED (NOT SURFACED WITH GRAVEL, RIPRAP, OR OTHER DESIGNATED MATERIALS) WITHIN THE LIMITS OF CONSTRUCTION. NO ADDITIONAL PAYMENT WILL BE MADE FOR TOPSOIL OR MATERIAL THAT THE CONTRACTOR NEEDS TO IMPORT FROM OFFSITE.
9. SITE GRADING SHALL PROVIDE FOR POSITIVE DRAINAGE AWAY FROM ALL STRUCTURES AND FOUNDATIONS UNLESS NOTED OTHERWISE.
10. CONTRACTOR SHALL CLEAR AND GRUB AREAS OF THE SITE AS NECESSARY TO PERFORM WORK. CLEARING AND GRUBBING SHALL BE PER SPECIFICATIONS.

STRUCTURE KEY	
120	ADMINISTRATION/VEHICLE STORAGE/ELECTRICAL CONTROL
210	HEADWORKS
320	OXIDATION DITCHES
350	SECONDARY TREATMENT
360	CHEMICAL STORAGE
380	CLARIFIERS
390	RETURN PUMP STATION
420	UV DISINFECTION
520	AEROBIC DIGESTERS
550	SOLIDS PROCESSING
570	BIOSOLIDS PUMPING
580	BIOSOLIDS STORAGE

1 SITEWORK
PLANT GRADING PLAN
SCALE: 1" = 80'

NORTH

PRELIMINARY
NOT FOR CONSTRUCTION

DRAWN BY: CMB, JST
APPROVED: MAR
CAD DATE: 8/1/2020 2:42:24 PM
CAD FILE: J:\2016\160473\CAD\Dwgs\C\C.04 PLANT GRADING PLAN.dwg
JOB DATE: 2020
JOB NUMBER: 160473

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen.com
HRGreen

NEVADA WWTF IMPROVEMENTS
CITY OF NEVADA
NEVADA, IOWA

SITE WORK
PLANT GRADING PLAN

SHEET NO.
C.04

Xrefs: xgl-1-dh01; XCS-BASE; XCS-DSGN; XCS-PARCELS; XCS-ROW; XCS-BLDG-INDEX; XCG-CONT-FG; XCP-PATT; XCU-ELEC; XCU-SAN; XCU-STRM; XCU-WATR; XVG-CONT-EG; XLS-DSGN; XLS-PATT

Appendix D

DRAFT

Nevada WWTP

Floodplains

Legend

- Rivers
- Proposed Nevada WWTP Design
- Parcels
- Building Footprint
- Floodplain Boundary

0 300 600 Feet

1 inch = 300 feet

HRGreen

HRG PLOT: 2:54:31 PM 8/7/2020 BY: jgutman FILE: J:\2016\160473\Design\Meeting\Drainage Meeting\90%\Stormwater Management Plan\Topography.mxd

H. Appendix H - Fire Protection Approval

NEVADA PUBLIC SAFETY DEPARTMENT

1209 6th Street – P.O. Box 530 Nevada, Iowa 50201 Tele: 515-382-4593

Ricardo Martinez II
Public Safety Director
Chief of Police

Josh Cizmadia
Police Sergeant

Chris Brandes
Police Sergeant

Ray Reynolds
Director of Fire & EMS

Cathy Jager
Chief's Assistant

July 21, 2020

HR Green
Michael Roth, PE
5525 Merle Hay Road. Suite 200
Johnston, IA 50131-1448

Mr. Roth:

I received the fire flow calculations for the proposed Nevada Waste Water Treatment Facility. The two issues reviewed involve the installation of an automatic fire sprinkler system to the chemical storage building and the acceptance of effluent water for a temporary solution to achieve required fire flows.

COMPLY AS FOLLOWS:

Permanent Variance:

The AHJ for the City of Nevada Fire Protection District approves the request *not* to sprinkle the chemical storage building. The approval of this variance request is based on the following conditions having been met:

1) Install a shutoff or switch accessible to firefighters outside the chemical storage building which will allow the discontinuance of electrical current to the building during a fire event (including back-up emergency electrical power). The shut off shall be located near or on the exterior of the chemical storage building.
Exemption: If ventilation fans are required to mitigate fire events, they can remain on emergency generator circuits.

2) Assure the building is properly labeled to show the hazard classification for the chemicals stored inside.

3) Assure the chemical tanks inside the chemical storage building are provided with secondary containment capable of holding 110% of the largest tank capacity.

4) Chemical leak detection and heat detection shall be installed to notify plant staff of an emergency situation in this building.

Justification:
The SDS sheets for chemical MicrocC2000 shows it to be a reducing agent for biological processes. The chemical is classified as a non-flammable solution. The chemical Ferric Chloride is a stable substance

which is also classified as non-flammable. The tank storage system is designed for the chemicals being stored. The building is non-combustible or ordinary combustible with high hazard classification electrical wiring. The building is not intended for routine human occupancy and serves no purpose other than for chemical storage. The approved omission of the automatic sprinkler system benefits the plant by directing water to fire flows needed for the human occupied spaces of the administration building. The tank size of 3,000 gallons, and 6,000 gallons do not pose a fire hazard. The fire risk remains electrical only. Installing the control measures above will mitigate any emergency in this building.

The priority of this office remains to provide the highest level of protection to spaces where workers will likely spend a majority of their time. The administration building and attached garage space will be high traffic areas for the workers. Thus, it is most important to make this building a priority with automatic sprinkler protection.

Temporary Variance:

The AHJ for the City of Nevada Fire Protection District temporarily approves the use of effluent water treated by the plant for non-potable fire protection needs. This variance approval shall be reviewed in 5 years (7-21-2025) to determine if fire protection remains adequate or to determine if additional water capabilities are provided.

Justification*:*
There have been documented issues regarding the inadequate flow of water provided by rural water associations in the area of Nevada. The installation of this plant is outside of the City of Nevada city limits. As such, the city is dependent upon water flow rates provided by rural water. This variance is needed due to the economic hardship of piping adequate water from the City of Nevada. The solution offers equivalent safety by providing an average 750 gpm fire flow when needed. This approval shall not serve as a permanent solution to inadequate potable water on site. If there is an increase of water capacity piped to the treatment plant by either the city or rural water association, or water storage capabilities are added, this variance may not be needed.

If you have questions, contact me at 515-382-4593.

Respectfully,

Ray Reynolds
Fire Chief